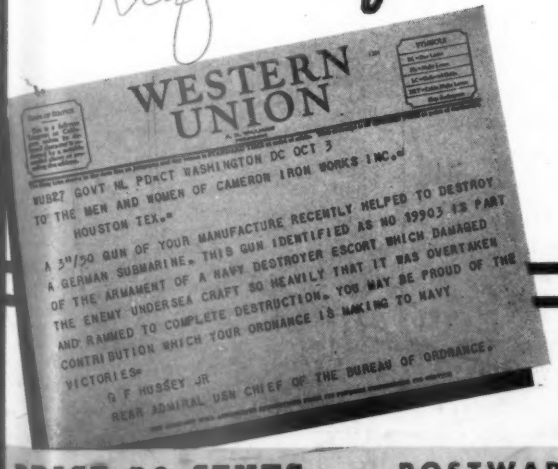
the OIL AND GAS JOURNAL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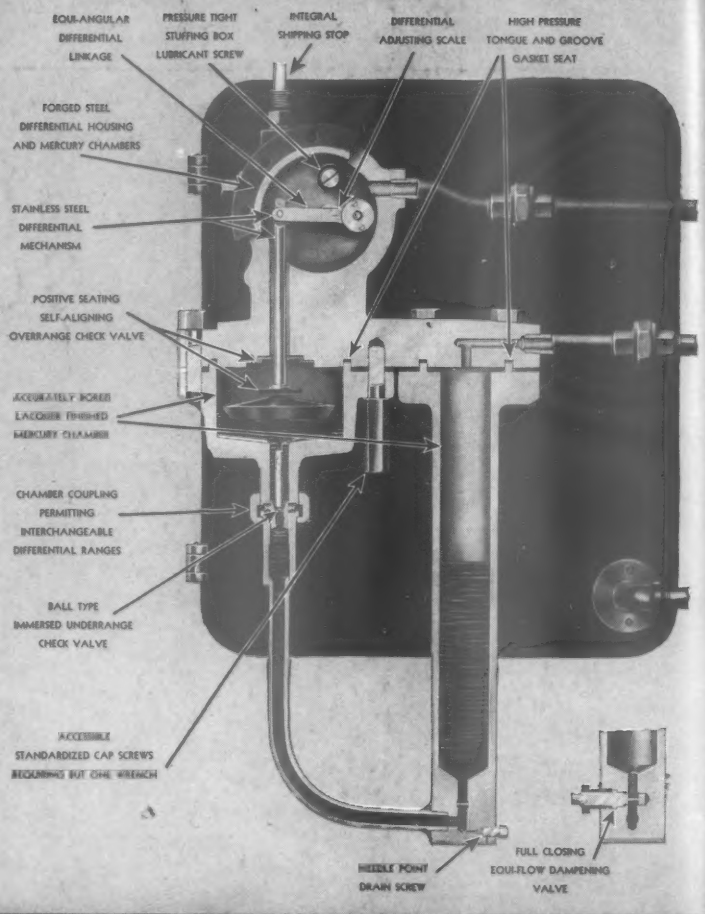
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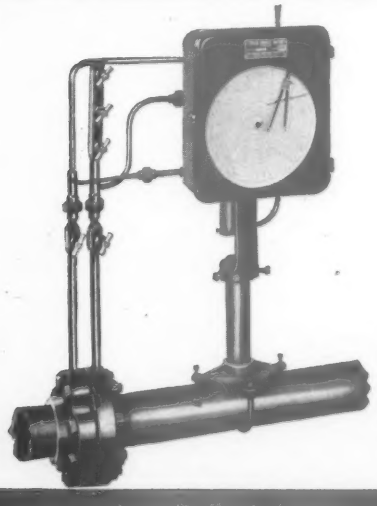

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the OIL AND GAS JOURNAL

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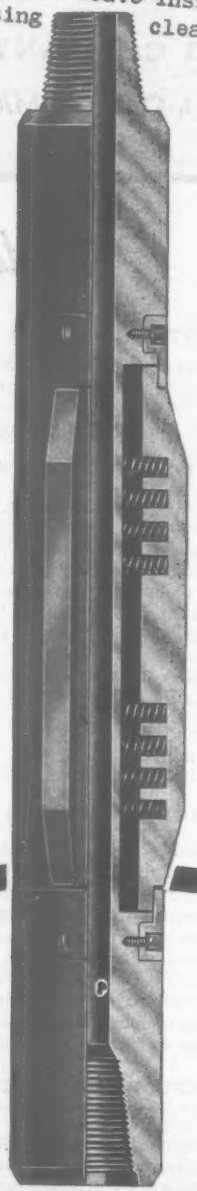

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BAKER OIL TOOLS, INC.

BAKER ROTARY CASING SCRAPER

The OIL AND GAS JOURNAL

Trends

Crude-Oil Production
By States—Page 266

CRUDE-OIL STOCKS 222,894,000 bbl. as of November 4—down 341,000 bbl. One year ago 236,937,000 bbl.

GASOLINE STOCKS 78,409,000 bbl. as of November 4—down 649,000 bbl. One year ago 68,674,000 bbl.

RESIDUAL FUEL-OIL STOCKS 63,444,000 bbl. as of November 4—down 938,000 bbl. One year ago 63,398,000 bbl.

GAS OIL AND DISTILLATE STOCKS 48,477,000 bbl. as of November 4—down 228,000 bbl. One year ago 44,807,000 bbl.

CRUDE-OIL PRODUCTION 4,731,850 bbl. as of November 11—up 12,500 bbl. One year ago 4,379,100 bbl.

REFINERY RUNS 4,570,000 bbl. daily week ended November 4—down 88,000 bbl. Year ago 4,097,000 bbl.

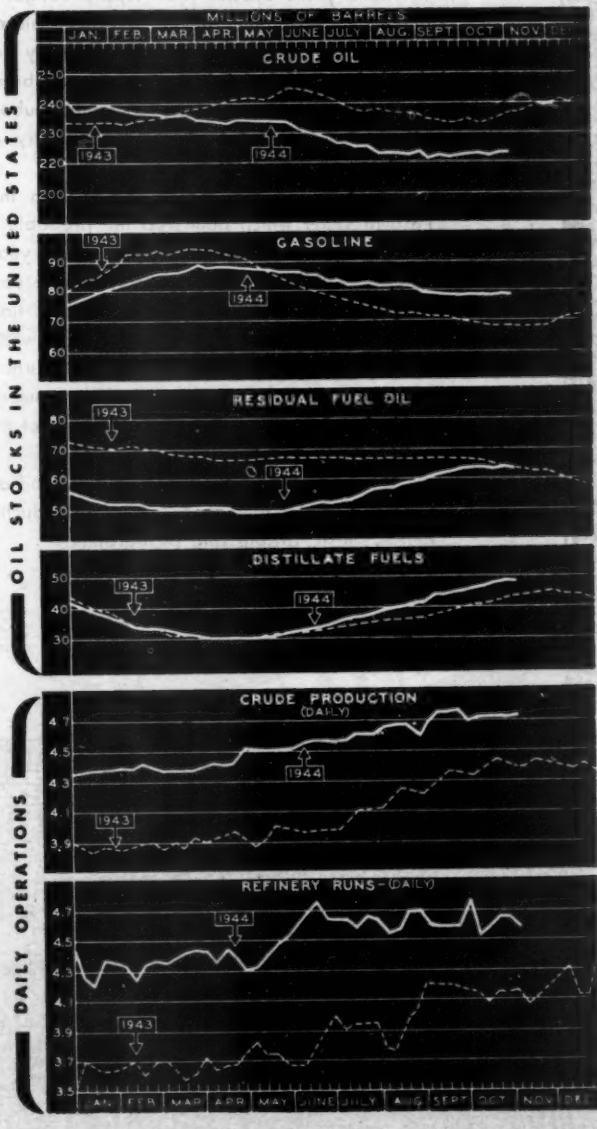
PRODUCERS and refiners for the first time in nearly 3 years again have a breakdown in weekly refinery operations covering the refining districts of Texas, Louisiana, Arkansas, and the East Coast. Shortly after Pearl Harbor for reasons of military security these districts were all combined in one area in the weekly reports of the American Petroleum Institute and other agencies and no information was available as to the operating trends within districts.

OPERATIONS within the previously censored area for the week ending November 4, 1944, compared to the week in 1941 which includes December 7, follow:

Area—	Daily runs to stills 1944	1943	1944 % increase
East Coast	731,000	624,000	17
Inland Texas	218,000	147,000	48
Texas Gulf Coast	1,093,000	985,000	11
Louisiana Gulf Coast	272,000	167,000	63
North Louisiana-Arkansas	72,000	50,000	44
Total	2,386,000	1,973,000	21

This table reveals that the percentage gain in crude runs to stills in the Texas Gulf Coast is less than any other refinery center and approximately half the percentage gain for the entire area. This comparatively small increase has materialized despite the fact that the area is now the principal refiner of 100-octane gasoline, toluene and butadiene. This means that refiners in that area which includes some of the largest plants of the industry and several smaller plants have concentrated their activities on the manufacture of war products from petroleum rather than the expansion of total capacity. In the Louisiana Gulf area the same situation exists except for the construction of the 75,000-bbl.-daily refinery of the Cities Service Oil Co. at Lake Charles.

THE growth in East Coast refinery operations based on crude runs to stills is also below the national average. Individual cases are cited in that section in which plant operations have been largely shifted to the refining of war products with practically the same crude-oil deliveries as in late 1941. In Inland Texas and Arkansas-North Louisiana where there are no large refineries and where war production is comparatively small, crude runs to stills have increased substantially.



THE time has come for the petroleum industry to turn more of its managerial thinking and technical talents to the peacetime years ahead. War supply obligations are undiminished and may rise higher, but the industry's plants have reached adequate productive capacity to meet military demands as they arise. Of course, the war production peaks must be sustained until the last shell is fired. Nevertheless, continued subordination of postwar affairs will be detrimental to the industry and is unjustified by conditions.

Consequently the Journal presents in the next 32 pages its Postwar study which points up the probable trends and course of domestic-product demand for the next 6 years. The mileposts are naturally subject to certain unforeseeable variations, but they are a compendium of the advice and suggestions of top economists and technicians throughout the industry who have cooperated in an exceedingly gratifying manner. The Journal's staff is most grateful for guidance and assistance of the numerous men in the operating and equipment manufacturing ends of the industry who made possible this comprehensive analysis.

Special attention is invited to the method of presenting pertinent data. All efforts have been aimed at reducing the information to simple charts, graphs and pictograms.

The Editors

POSTWAR

SECTION

RETOOL • REPLENISH • REHABILITATE

HERE'S WHY . . .

1 **Total of 34,000,000 automobiles, vastly expanded commercial and private flying are chief factors in boosting gasoline-demand forecast to 860,000,000 bbl. annually.**

2 **Home heating units will rise to 3,600,000 or more, stimulating demand for distillate fuel oil to unprecedented peaks.**

3 **Diesel engines, hence fuels, assured more important position in industrial and commercial services, particularly in railroad operations.**

4 **Specialties, such as synthetic rubber, chemicals, and plastic raw materials will persist in the postwar period to absorb increasing quantities of petroleum liquids and gases.**

DEMAND for nearly 1.9 billion barrels of oil by 1950 confronts the domestic petroleum industry with a stupendous postwar task in retooling its facilities, replenishing its reserves and productive capacity and in rehabilitating properties in all of its branches. Scope of the assignment is best illustrated by the all-time record demands which will develop in 1948 and continue upward. Immediate postwar reconversion in the petroleum industry, declared by top operating men to be without particularly difficult problems, does not accurately measure the 5-year outlook.

Demand for all domestic petroleum in 1950, for example, will rise to 1,895,000,000 bbl., an increase of nearly 150,000,000 bbl. over the wartime peak in 1944, and more than 300,000,000 bbl. above the prewar record requirements in 1941.

Reserves must be restored to support sustained production of 5,100,000 bbl. per day of liquid petroleum products, probably about 4,700,000 bbl. of crude and 400,000 bbl. of condensate and natural gasoline. This means that about 14 billion barrels of proven reserves must be discovered over the next 6 years. Comparative smallness of recent discoveries dictates extreme exploration activity to make up in numbers what new fields lack in performance.

Completions must average about 37,700 wells per year in order to restore the average per well daily production of 9.1 bbl. in normal prewar years and to reestablish a reserve ratio of 13.8 to current withdrawals.

Refining capacity must be advanced to about 5,100,000 bbl. daily in order to meet record requirements for products and to create a normal cushion between operating and total capacity.

Transportation facilities must be supplemented to handle daily traffic of approximately 9,000,000 bbl. of crude oil and products to achieve most economic conditions for gathering and delivering crude oil to refineries and for distributing products to consuming centers.

Basic assumptions throughout this section devoted to the domestic petroleum industry's postwar outlook are these:

1. The global war will be concluded late in 1945 or very early in 1946.
2. Government restrictions will be abolished promptly at the end of the war.
3. Industry will be returned unreservedly to private management at war's end.
4. Free competition will prevail in all industry, stimulating production and development of oil-consuming machinery.
5. Prewar social and economic forces inimical to industrial expansion will be modified, permitting business to supply the jobs necessary to rehabilitation of returning service men.

General Concepts of Demand

Without reservation, the long-term postwar outlook for the oil industry calls for another era of uninterrupted increases in consumption. First, how-

FORECAST OF REQUIREMENTS BY 1950

PRODUCTION	REFINING	TRANSPORTATION
5,100,000 BBL. DAILY	5,600,000 BBL. DAILY	9,000,000 BBL. DAILY

These over-all requirements will be needed to meet the record demands projected for all oils. Retooling, replenishment and rehabilitation in their broader connotations are necessary in every branch of industry.

THOUSANDS OF BARRELS

ever, 2 years of modified demand are in prospect because of the timing on the Japanese campaign. There will be an inevitable lag in requirements from the time Germany is defeated until industrial reconversion is completed 6 to 9 months after Japan falls. During this interim, most of the civilian restrictions will continue but to a modified degree.

The near-term outlook, assuming early termination of the European war, calls for substantially the same volume of petroleum as is currently required. Shift of emphasis from Europe to the Pacific theater when Germany capitulates will, however, mean adjustments in the volume of various products. Most authorities anticipate, for example, a decline of about 200,000 bbl. per day in demand for 100-octane gasoline. This same volume of oil or more will be required in the form of residual and diesel fuel for maintenance of the longer supply lines to military bases within range of Jap-controlled positions.

Four Near-Term Developments

At least four developments appear probable as soon as Germany is defeated: (1) A slight modification in civilian-gasoline restrictions will occur; (2) fighting-grade gasoline will be made available for final stages of training heavy-bomber crews in this country; (3) higher quality aviation fuel (the 115-145 grade) will be supplied more combat planes, and (4) some of the butylene currently required for aviation gasoline will be diverted to synthetic-rubber plants in order to bring their production up to capacity.

The only significant contraction of petroleum consumption in the postwar area is indicated for 1946, part or most of which will be required for reconversion to peacetime production in the automobile industry, home building, burner manufacturing and numerous other phases which make up the over-all demand picture for petroleum.

More moderate declines in 1945 are based on assumptions of minor contractions in military requirements and on the deficiency of new tires and new automobiles for full replacement of those in civilian and industrial service. Mortality rate of prewar automobiles will set a peak in 1945 of nearly 2,000,000 units and the average number of vehicles in service will decline to about 23,500,000.

Motor-Fuel Outlook

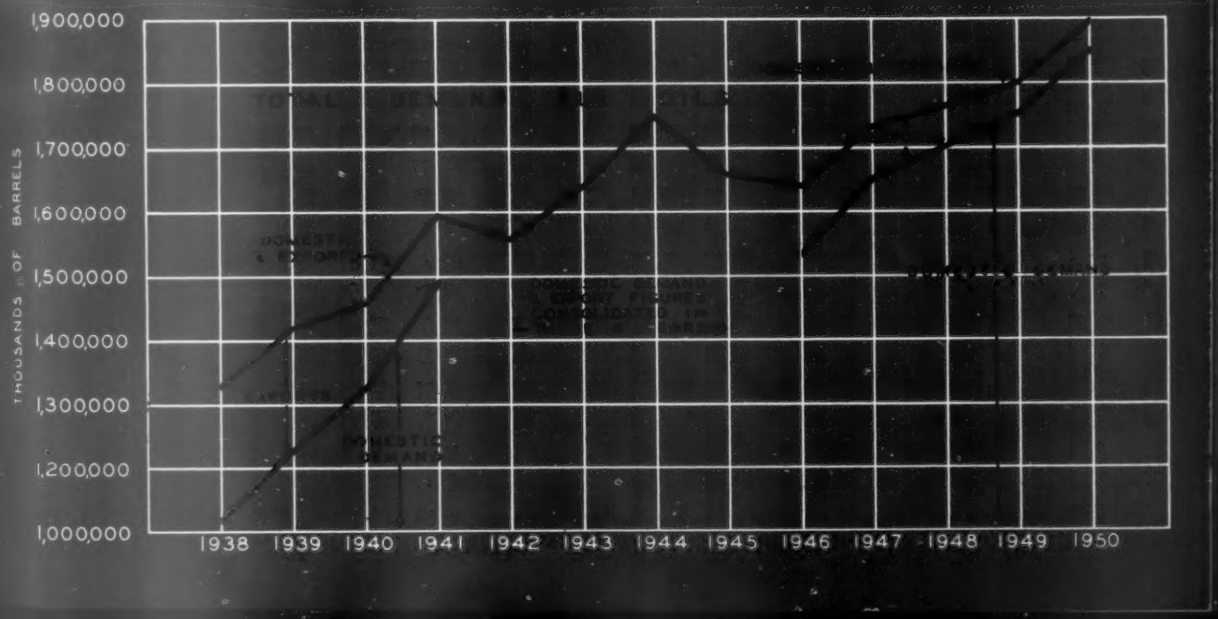
Domestic demand for motor fuel, including aviation gasoline, is expected to average 2,019,000 bbl. daily in 1948, exactly the same as is estimated for 1944, although the latter figure includes exports and is not, therefore, directly comparable. Thereafter, the daily requirements for motor fuel are expected to rise to 2,104,000 bbl. daily in 1949 and 2,307,000 bbl. in 1950.

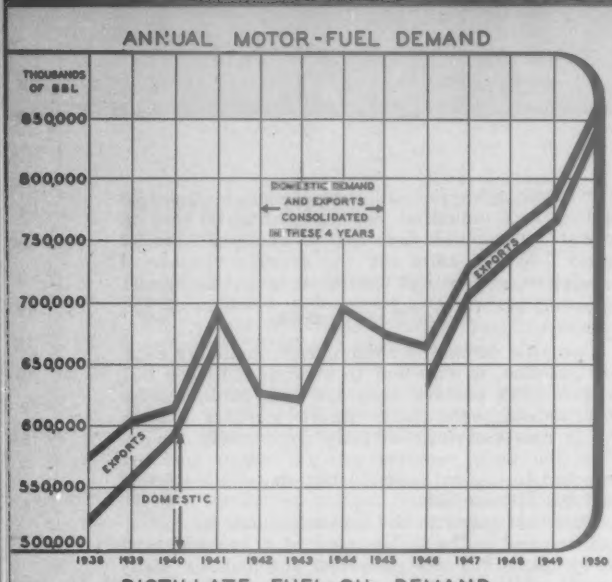
Foremost factor in the 5-year outlook for motor-fuel demand is the unjamming of a backlog market for 20,000,000 new passenger automobiles. Many aspects of the postwar automobile are industrial secrets but there is substantial agreement on the number to be manufactured and sold. Therein lies the medium of demand for a peak of 841,950,000 bbl. of motor fuel anticipated in 1950.

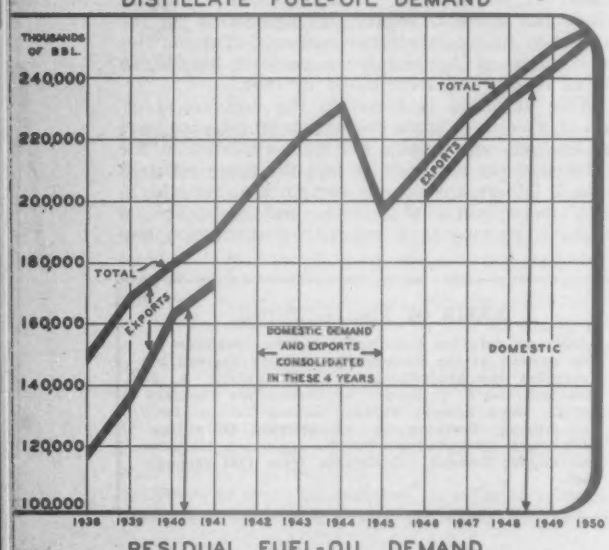
Wide variation is found in the unit consumption of gasoline. Some economists emphasize savings in fuel consumption per mile expected in the lighter postwar automobiles and the more efficient engines. Others are equally certain that superhighways, more hours of leisure, and insistence of American motorists on superior performance and

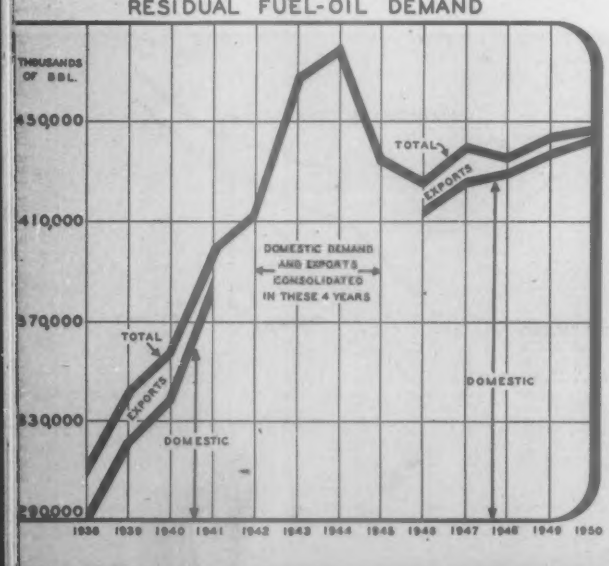
BASIS OF PROJECTIONS

Demand data for principal petroleum products in this portion of the Postwar Section are derived by averaging the projections of C. L. Burrill, A. J. McIntosh and E. T. Knight, economists for Standard Oil Co. (New Jersey), Socony-Vacuum Oil Co., Inc., and Atlantic Refining Co., respectively. Only Burrill's report was available for the combined domestic and export demand calculations from 1942 through 1945.









comfort in their automobiles will offset the engineering economics of operation, and will require about 1 gal. for 16.1 miles of driving.

The anticipated peak of postwar aviation-gasoline requirements will not be realized until 1950 when consumption is expected to rise to 115,000 bbl. daily with about 40 per cent earmarked for military aircraft, 50 per cent for commercial airlines and the remainder for private-plane operation. Future requirements for aviation gasoline, of course, appear small compared to current consumption of approximately 550,000 bbl. daily but constitute, none the less, an important factor in the sustained upward movement of the postwar gasoline-demand curve.

Total demand for domestic gasoline will rise to 2,342,000 bbl. daily in 1950, an increase of 28 per cent over the postwar low of 1,819,000 bbl. per day in 1946. Domestic requirements alone will account for 2,307,000 bbl. daily, up 32.6 per cent from the low forecast of 1,739,000 bbl. daily 2 years hence.

Diesel and Distillate Fuel Oil

Resumption of sharp inclines in the number of home-heating burners, in industrial and commercial applications of diesel engines and utilization of tractors in agricultural work will lift consumption of distillate oils to nearly 255,000,000 bbl. annually.

Eighty-five per cent of the domestic distillate-fuel requirements consist of home-heating oil and diesel fuel, both of which categories are certain to increase rapidly with termination of war. The rate of dwelling construction is expected to rise to 750,000 units annually, possibly to 1,000,000 houses, by 1950. From the current total of 2,300,000 burners in service, new installations will increase this figure to at least 3,500,000 by the winter of 1950.

Admittedly, the wartime surge of diesel-fuel consumption cannot be sustained in the postwar period. There is emphatic indication, however, that diesel power, proven adequate and reliable in the whole gamut of military and industrial services during the war, will lose only that portion of its gains of the past 3 years which can be classified as strictly military. Diesel engine production, for example, has risen from a prewar peak of 1,910,607 hp. in 1939 to an estimated total of 35,000,000 hp. this year. Customarily, diesel-fuel consumption absorbs about 15 per cent of the domestic requirements for all distillate fuels. This percentage will rise probably to 17 or 18 per cent, indicating that diesel-fuel requirements by 1950 will be about 43,000,000 bbl. annually.

Popularity of tractors has spread immeasurably in agricultural districts under the pressure of record demand for foodstuffs. Tractors will continue to consume only nominal volumes of distillate fuel of qualities approximately equivalent to kerosene. The vast expansion in the number of tractors in service, however, cannot but influence the upward curve of fuel requirements. The majority of tractor operators will prefer to pay higher prices for gasoline and enjoy the superior characteristics of performance.

Percentagewise, the anticipated growth of diesel power in railroad operations parallels the outlook for increases in other channels of distillate-fuel consumption. Before the war, railroads used less than 3,000,000 bbl. of diesel fuel oil annually. Econ-

omists expect the rate to double by 1950, after clinging to a level of 4,500,000 to 5,000,000 bbl. from 1945 to 1948. At the record figures of 6,000,000 bbl. in railroad consumption of diesel fuel in 1950, this type of product will account for nearly 7 per cent of petroleum required for locomotive operation.

Only moderate rises will occur in consumption of distillate oils and diesel fuel in the generation of electric power, combined totals of which amount to around 6,000,000 bbl. annually.

Residual Fuel-Oil Outlook

Probable requirements for 1,221,000 bbl. of residual fuel oil daily in 1950, a projection more closely related to forecasts of industrial activity than any other petroleum product, culminates a gradual upward movement expected to develop in 1948. The moderate decline of 13,000 bbl. per day in total requirements for residual fuel in 1948 compared to 1947 constitutes an anomaly with the demand curves on other products.

Although naval operations and military shipping requirements will drop precipitously at war's end, exports from this country will remain at relatively high levels for the first 2 years of peace because of the need for residual fuels in restoration of industry and rehabilitation in European countries. Until a minimum of 2 years after the war ends, European refineries will be unable to supply any substantial portion of internal requirements, placing dependence on United States, South American and Middle East suppliers. When European refining facilities are rehabilitated, residual fuel-oil requirements from this country will decline along with the calls for other products, although the timing is somewhat unconformable.

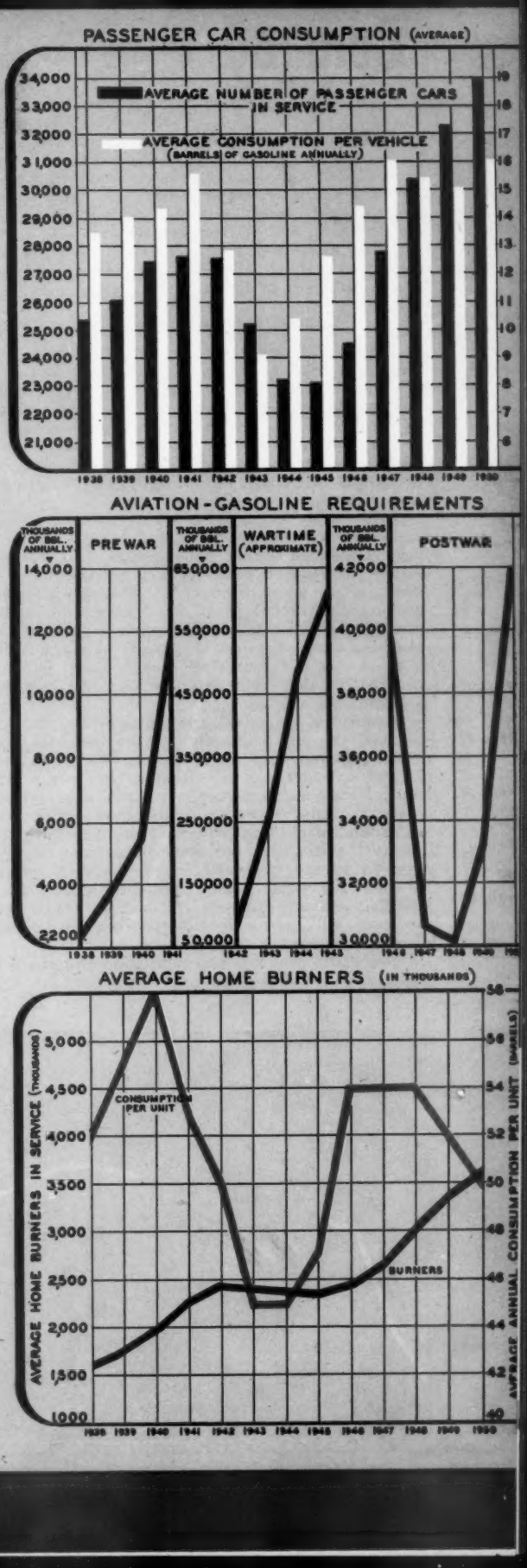
The only significant discrepancy in the forecasts of petroleum economists on the probable consumption of residual fuel oil is in their assumptions on naval requirements. Higher estimates involve assumed consumption by the Navy in 1950 of 60,000,000 bbl. of residual fuel oil while the lower calculations place this factor at 30,000,000 bbl. There is substantial agreement that other requirements for residual fuel oil in 1950 will be of this order: 70,000,000 bbl. for heating; 95,000,000 bbl. in manufacturing operations; 40,000,000 bbl. in gas and electric utility operations; 80,000,000 bbl. for railroads; 70,000,000 bbl. for merchant shipping; 50,000,000 bbl. for direct oil company utilization and around 9,000,000 bbl. in miscellaneous services.

Lubricating Oils and Waxes

The influence of aviation and record automobile operation is particularly strong in lubricating oils which will rise to peacetime peaks in 1947 and continue generally up until hitting a level of 44,000,000 bbl. per year in 1950. The indicated postwar consumption compares to the peacetime peak in 1941 of about 42,000,000 bbl. Waxes are converted into terms of barrels in this analysis at 8 bbl. per ton.

Kerosene Requirements to Decline

The inflated demand for kerosene during the war and in the first 2 or 3 postwar years is expected to recede to normal prewar levels, following somewhat the same trend as indicated for residual fuel. Exports will be chiefly responsible for continuing the demand curve upward to 1947 and



Demand

in modifying the rate of decline to normal rates.

Volumewise, however, the indicated decline from 216,000 bbl. daily in 1946 to about 197,000 bbl. per day in 1950 is insignificant. The export situation is based on the theory that shipments from this country will be comparatively heavy during the first 2 postwar years. Most of the exports to Asia will terminate as soon as Netherlands East Indies refineries are restored to normal operations.

Exports Become Less Important

Exports become a diminishing factor in the long-term postwar prospects because of the fully documented evidence that foreign petroleum development will be pushed with vigor proportionate to activity in the United States. Furthermore, the problem of meeting domestic requirements from indigenous supplies appears certain to become increasingly difficult, militating against a return to prewar levels of offshore movement.

Particularly difficult will be return to prewar exports from the Pacific Coast where numerous discoveries and active development will be necessary in order to delay as long as possible shipments either from the Gulf Coast or from foreign producing countries. Only by drawing on certain reserves in California which will not be available after the war and by rail shipments from the Rocky Mountains and Texas is the Pacific Coast industry enabled to meet current military and essential civilian demands.

Exports of crude oil and refined products will diminish to approximately 129,000 bbl. daily by 1950 compared with a prewar peak of more than 357,000 bbl. per day of off-shore shipments. The rate of increase in domestic requirements for the postwar years, however, more than offsets the anticipated decline in exports, leading to the probability that imports will rise to dominance in foreign petroleum trade. Prewar imports ranged up to about 230,000 bbl. daily, consisting of half crude and half refinery products. Not before 1948 or 1949, however, will petroleum exports from this country recede to a normal postwar rate.

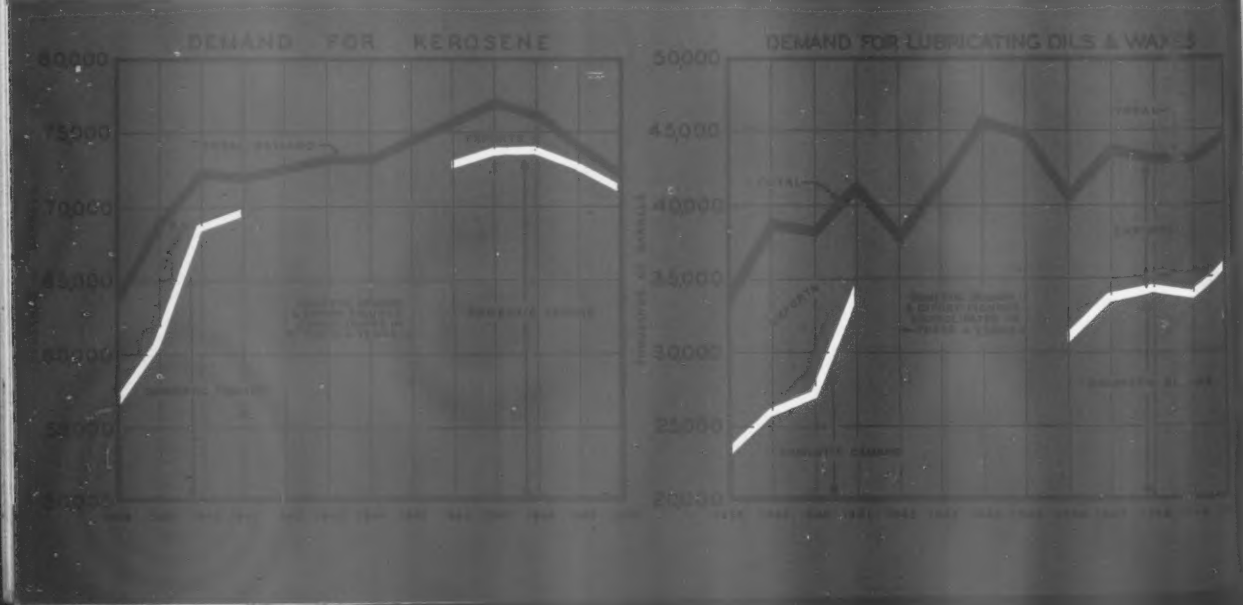
One of the reasons why petroleum shipments to Europe will not decline appreciably in the first 2 or 3 years after Germany is defeated is because practically all refineries on the continent have been destroyed or seriously damaged first in the western retreat of the Allied forces, the saturation bombing attacks on strategic war plants before the Normandy invasion and finally in the Nazi withdrawal. Plants in eastern Europe have been subjected to virtually the same whipsaw and it is obvious from air reconnaissance that German refineries are now or eventually will be practically useless. Pending restoration of refining capacity in Europe, already planned in rehabilitation studies, the United States, Latin-American, and Middle East refineries must supply the bulk of products essential to rebuilding the battle-scarred continent.

Likewise, exports will decline with restoration of refineries and completion of the Pacific phase of the war when the record tanker fleet will become available for transporting crude oil from South America and Middle East producing countries for processing in the European consuming centers.

NATURAL GASOLINE and cycle products, particularly liquefied petroleum gases, seem destined for another era of rapidly expanding demand. Production at cycle plants, including liquefied petroleum gases, isobutane and other light hydrocarbons has shown the most phenomenal growth during the war and promises to continue even more prominently in the postwar years. Cycle products are produced currently at the rate of nearly 60,000 bbl. daily, chiefly in Texas and Louisiana, compared with output of 48,500 bbl. at the start of last January.

Cycle plant operation has become intimately associated with advanced conservation practices and its growth is assured with numerous projects already in final stages of planning for execution as soon as fabricated steel vessels, compressors and other materials are available. Cycling operations in many fields are a phase of pressure maintenance, contributing to ultimate recovery and the proportion of recoverable oil lifted to the surface with inherent pressure of the reservoir.

The expanding market for petroleum liquids and



gases as raw material for synthetic chemicals is the principal new outlet for natural-gasoline manufacturers and cycle-plant operators. Incentives for splitting out isobutane and isopentane in natural-gasoline and cycling operations may diminish temporarily with deemphasis of the aviation-gasoline, synthetic-rubber and other synthetic chemical production but their diversion to equally valuable peacetime products awaits chiefly the opportunity to make the switch.

Combined production of natural gasoline and allied products currently averages approximately 300,000 bbl. daily, including materials which are used directly in operations of the industry. At the start of 1944, for example, the daily output was less than 275,000 bbl., despite the relatively high losses resulting from superfractionation of the products to obtain wartime requirements of the iso compounds.

Central fractionation plants for further processing of various hydrocarbon components of natural gasoline probably will continue after the war, certainly in areas where the concentration of elementary natural-gasoline manufacturing plants affords a suitable concentration of raw material.

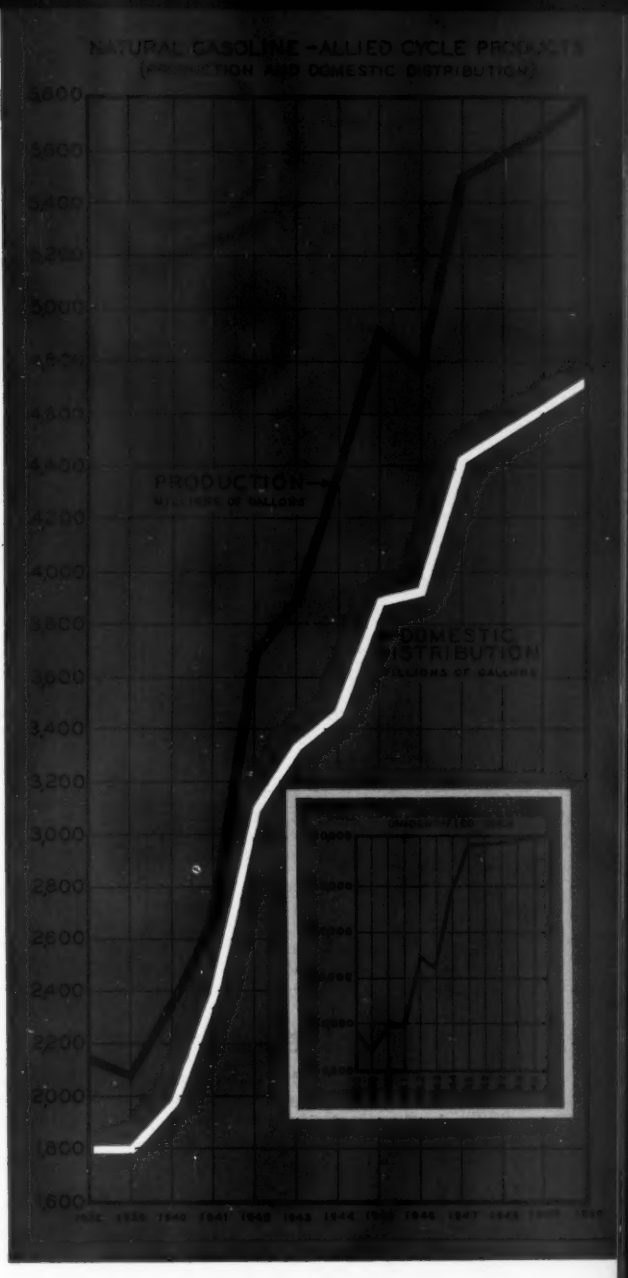
SYNTHETIC RUBBER production from petroleum hydrocarbons has established a record of plant performance and costs qualifying it to continue with little abatement in the postwar era. Limitations, such as scarcity of equipment, manpower and raw materials, should largely disappear in the postwar years, permitting substantial broadening of the industrial applications for which synthetic rubber is peculiarly competent.

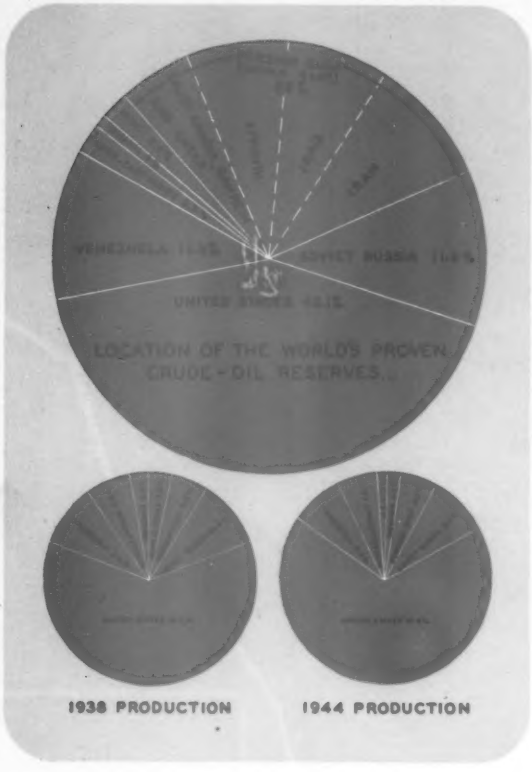
The 16 government owned plants operated by petroleum refiners for production of butadiene and butyl rubber have rated capacity of 474,000 short tons annually. Because of the lower operating costs prevailing in the butene-butane dehydrogenation process (approximately 7 cents per pound of butadiene without charges for amortization) it is apparent either that this method will prevail in the postwar period or other competitive processes must undergo substantial adjustments. The 16 plants represent investment of $283,086,000.

Some of the first constructed synthetic-rubber plant facilities in the government program are already obsolete and will require redesigning and rebuilding in order to compete on a purely commercial basis. The high rate of obsolescence caused by the inescapable necessity of "bulling" the program through does not, however, detract from the certainty that synthetic rubber for civilian consumption is a new industrial material which will reach its full commercial fruition in the early postwar period.

The number of consumer products which can be made from synthetic rubber in its highly versatile forms is growing almost daily. Even before the war interrupted developments, petroleum refiners and rubber companies had amassed a long list of consumer articles which could be made more durable and more serviceable from synthetic rubber than any other known material. Experience and developments during the war applied exclusively at the moment to military materials will form the nucleus for postwar operations forcing retention of a high percentage of current butadiene capacity.

The patent situation of synthetic-rubber manufacturing has been clarified to a point during the war which will permit commercial operations in the peacetime years ahead without prohibitive royalties and other restraints.





ESTIMATED CRUDE-OIL PRODUCTION
(Yearly figures in thousands)

Countries—	1943 total	1944 operations— Total	Dly. av.
North America:			
United States	1,502,120	1,700,000	4,644,809
Canada	10,100	8,700	23,770
Mexico	34,650	38,000	103,824
South America:			
Venezuela	182,500	205,000	560,109
Colombia	13,450	23,000	62,841
Peru	14,600	15,000	40,984
Ecuador	2,500	3,000	8,197
Argentina	24,000	24,000	65,573
Bolivia	290	250	683
Brazil	280	125	342
Trinidad	22,000	22,000	60,109
Europe:			
Germany*	10,950	23,700	64,754
Italy†	750	800	2,188
England	985	750	2,049
Hungary	5,475	(See Germany)	
Romania	36,500	36,500	99,726
U.S.S.R.‡	237,250	219,000	598,361
Asia:			
Iran	75,000	100,000	273,224
Iraq	27,375	28,000	76,503
Bahrein Island	7,300	6,800	18,579
Saudi Arabia	5,475	9,500	25,956
India	2,800	2,900	7,923
Burma	(No Estimate)		
Japan§	3,800	3,800	10,383
Neth. East Indies‖	18,250	22,000	60,109
China	730	1,100	3,005
Africa:			
Egypt	9,125	9,500	25,956
Other countries	350	1,100	3,005
World total	2,248,405	2,504,525	6,842,980

*Includes occupied countries. †Includes Albania. ‡Includes Asiatic U.S.S.R., part of Sakhalin. §Includes Formosa, part of Sakhalin. ‖Includes Brunei, Sarawak.

Supply

WORLD CRUDE-OIL output in 1944 will total an estimated 2,504,525,000 bbl., a daily average of 6,861,712 with most producing countries at capacity levels. This exceeds the total for 1943, the previous peak, by nearly 200,000,000 bbl.

The large increase in world petroleum supplies of the past year reflects the fact that the United Nations has taken the offensive on several war fronts requiring constantly expanding petroleum output. If October figures were substituted for the 1944 averages, daily crude-oil output would jump to approximately 7,200,000 bbl. daily or at the yearly rate of 2,628,000,000 bbl. These totals compare with the following daily averages since the world conflict began: 1943, 5,616,300; 1942, 5,650,670; 1941, 6,101,710; 1940, 5,837,611; 1939, 5,667,582 bbl.

Economists of the petroleum industry have not attempted to project world petroleum supplies and demands into the postwar period. In general, it is felt, that world trends in the immediate postwar period will follow rather closely the trends in the United States which accounts for more than 65 per cent of the world output and consumption.

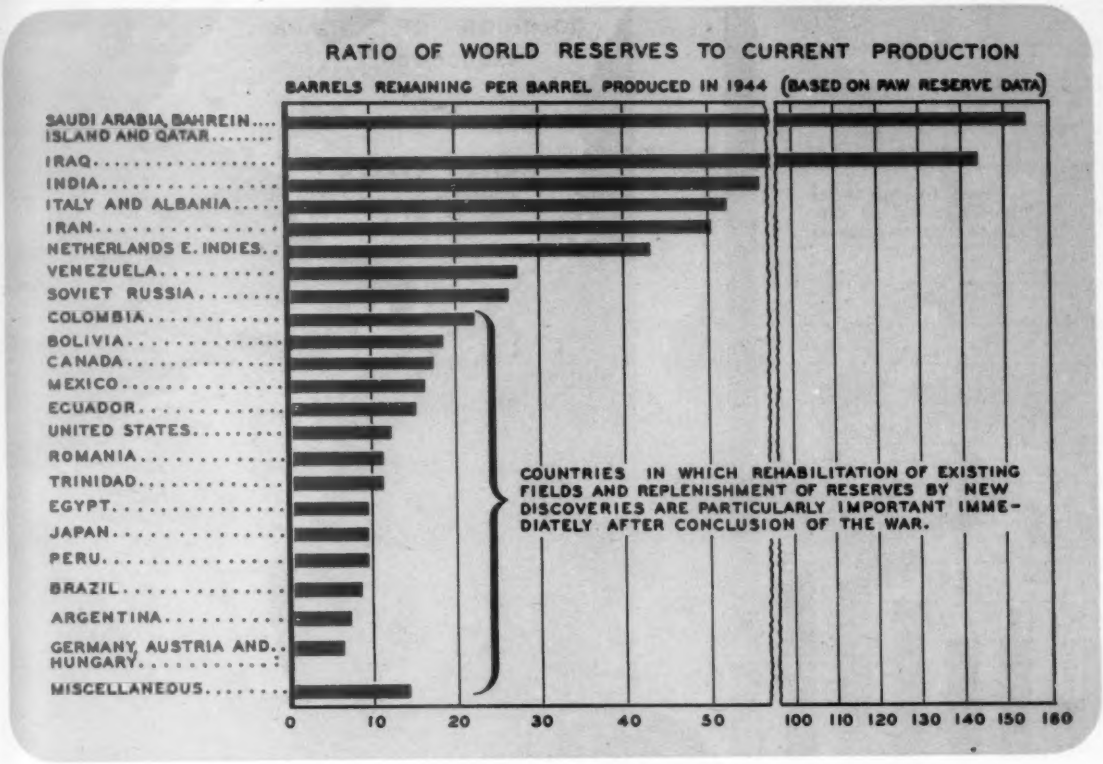
Over a period of 5 years or longer world observers feel that the large new reserves which have been discovered in the Middle East will absorb those markets of the Eastern Hemisphere which in the prewar period were supplied by the Western Hemisphere. There are those who conceive of a future situation, brought about by competitive conditions including failure to find adequate new reserves in the United States, in which this country and other parts of the Western Hemisphere would look to the Eastern Hemisphere for part of their petroleum requirements.

It is conceded that this reversal in the movement of petroleum between continents is not a near-term probability with many economists stressing the vast petroleum markets of the Eastern Hemisphere as the probable source of demand for any future increases in output. It is pointed out in this connection that the Eastern Hemisphere with more than 70 per cent of the world's population now accounts for approximately 20 per cent of its petroleum demands.

Probable Changes Next Year

The probable changes in 1945 world production, should the war developments require the maximum output of petroleum for the United Nations, reflect those shifts in supply brought about largely by new discoveries and additional refining and transportation capacity. Some of these facilities are under construction at this time.

Crude-oil production in Venezuela which increased to more than 800,000 bbl. daily in October will be expanded to around 925,000 bbl. daily by the end of the year provided there is continued strong demand at that time. This will be brought about by the completion of a large new line and



an increase in the capacity of an existing line, both located in eastern Venezuela. It is estimated that Venezuela's production could be maintained at 1,000,000 bbl. daily or higher for an indefinite period if required after V-Day.

Colombia's production which has been expanded to 66,000 bbl. daily can be increased to approximately 80,000 bbl. when present pipe-line facilities including additions to capacity now being made, are completed. Except for a small increase in Mexico no other Latin-American countries are in a position to increase their output over present levels until considerable development work takes place and additional transportation is provided.

Brazil and Bolivia whose present output is significant are hopeful of bringing about a large increase in their production as soon as equipment and materials are available. More active exploration and exploitation are also planned for Mexico and Argentina whose production has shown little change over the past year.

Eastern Hemisphere

In the Eastern Hemisphere, Iraq is once more exporting the 84,000-bbl. daily capacity of its pipeline system with terminals in Haifa, Palestine and Tripoli, Syria. Plans have been announced for doubling the capacity of the line and it is believed that this will be a development of the early postwar period. At present the crude oil at both terminals is being refined at the new refinery at Haifa the capacity of which is now approximately 80,000 bbl. daily.

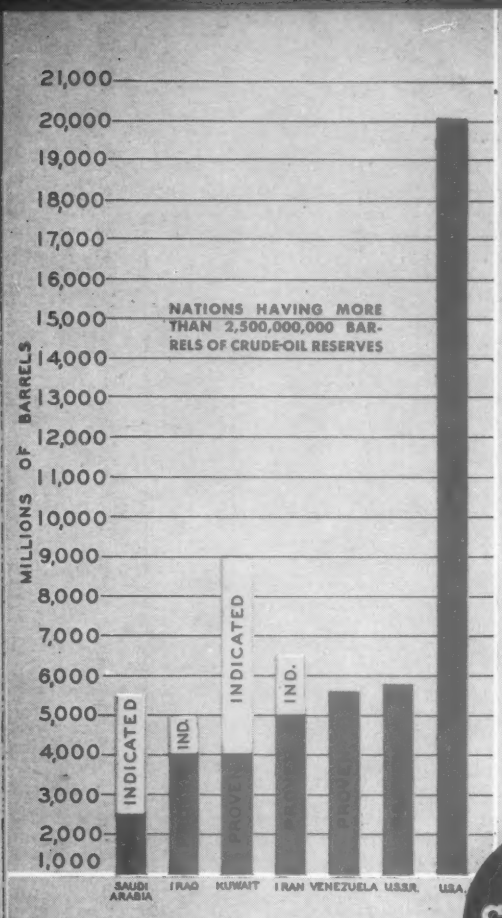
The net production of Iran at this time is estimated around 285,000 bbl. daily not including the residual oil of 28,000 bbl. daily which is returned to the producing formations. This production is to be increased before the end of the year when the refinery at Abadan, Iran, will be expanded to 320,000 bbl. daily. It is stated that construction work is under way which will increase this capacity to nearly 400,000 bbl. daily next year.

Bahrein Refinery Capacity Enlarged

The refinery on Bahrein Island which now refines the production of that country amounting to 20,000 bbl. daily plus small imports from Arabia is being increased to 55,000 bbl. daily. The additional crude oil required will be supplied by pipe line from Saudi Arabia. A large new refinery is also under construction at Ras Tanaru in Saudi Arabia. When this plant and that of Bahrein Island are completed next year the production of Saudi Arabian crude oil will be increased to approximately 100,000 bbl. daily.

At present Kuwait and Qatar of the Middle East with large known reserves are not producing crude oil commercially. The established reserves of this middle-eastern area including Iran, Iraq, Saudi Arabia, Kuwait and Qatar would support a production several times the present output, a fact that will be of major importance in postwar operations.

Little is known regarding the war production of petroleum of the U.S.S.R. An estimated total of 600,000 bbl. is generally used in arriving at world totals. It is known that new fields have been dis-



SUPPLY

covered in recent years and it is assumed that the petroleum output of the country will be substantially increased in the postwar period.

The U.S.S.R. at present is in possession of Romanian oil fields and refineries and part of the petroleum properties of Poland. The output of Romania in recent years has varied from 100,000 to 140,000 bbl. daily with total refining capacity of several plants in excess of the available crude-oil supply. Information from prewar owners of these facilities indicates that there will be no increase in field output until there has been time to carry on exploration and development work in new areas.

Invaded Countries

The Netherlands and British East Indies were producing and refining approximately 175,000 bbl. daily in 1942 when invaded by the Japanese. It is estimated that present output under Japanese operation is approximately one-third this total. When these oil properties are returned to their American, British and Dutch owners at the end of the war, considerable time will be required to complete rehabilitation work and resume the prewar production level. The entire area is credited with oil reserves which would support production in excess of the psewar output if it is required in the postwar period.

While official reports are lacking, available information indicates that the crude-oil production of Austria and Hungary has been increased substantially under German domination. Austria is credited with a production around 30,000 bbl. daily and Hungary 15,000 bbl. daily. The production, it is understood, is coming from fields discovered by American and British interests previous to the start of the war.

Mexico Needs Postwar Drilling

The discovery and development of new fields in Mexico will be necessary in the postwar period before there can be a material increase in the country's crude-oil production now averaging approximately 110,000 bbl. daily. While the Poza Rica field from which a large part of the country's production is coming at this time, is one of the largest single oil reserves of the petroleum industry, it is now stated that any large increase over present production levels, would mean a sacrifice in ultimate recovery.

The production of Trinidad has been expanded to around 60,000 bbl. daily and further increases are not feasible until new fields are discovered. The domestic output is being supplemented with crude-oil imports from Venezuela. Recent reports also indicate that Canada's production except for

the Fort Norman area cannot be expanded until new fields have been discovered. Outlets for Fort Norman production are confined to the needs of a refinery located at Whitehorse and local requirements in the field area.

RESERVES in the world's proven pools are estimated at slightly more than 50 billion barrels. A little more than half of the total is credited to the Western Hemisphere which, the production table in this section shows, is supplying 76 per cent of the current world withdrawals of crude oil. Substantial additions have been made in recent months to Venezuelan reserves and that country's proven supply is at least 8 billion barrels now instead of the 5.6 billion credited in the Petroleum Administration for War report. Upward revisions also are in order for Colombia because of recent discoveries and development operations.

Following the United States in proven reserves and more than equal to its supply if indicated productivity is considered, is the Persian Gulf district. Reserves there are scattered through five different kingdoms and sheikdoms but they are generally considered to compose a single petroleum province. Definitely proven reserves of the Persian Gulf total 15.5 billion barrels but if the indicated reserves in fields already discovered but not yet fully explored are included the supply in sight rises to 32 billion barrels, more than half again larger than those of the United States.

Russian reserves are calculated at the nominal figure of 5.7 billion barrels but scraps of evidence seep through that country's rigid system of censorship indicating that this figure would be doubled or trebled by full disclosure of the facts.

One of the most intriguing postwar industrial disputes is shaping up in the Middle East where United States interests, Great Britain and Soviet Russia are attempting to acquire new concessions in Iran. Certain to receive intensive exploration in the postwar era are Egypt, Palestine, untested portations of the Saudi Arabian coastline and interior geological features, Syria and Trans-Jordan. Other territory along the west coastline of the Red Sea and the Gulf of Aden is considered prospective. Recently Iran rejected overtures for concessions from U. S. companies, Great Britain and Russia, saying action would be deferred until more settled conditions prevail.

The ratio of current withdrawals to remaining reserves is particularly high among the Western Hemisphere producing countries, indicating that replenishment of proven supplies by aggressive exploration and development is particularly critical

in this part of the world. The Persian Gulf producing countries, for example, are withdrawing only 1 bbl. to each 134.6 bbl. of proven reserves. Three North American producing countries, in contrast, are drawing on their reserves at a ratio of 1 to 11, showing strong urgency for replenishment. South American producing countries are drafting reserves at the current ratio of 1 to 25, although the factors might easily become 1 to 40, although development is required to transfer indicated reserves by recent discoveries to the definitely proven column.

Operations to Be Intensified

There is little doubt that operating companies will intensify exploration and development in keeping with current and projected expansion of transportation and refining facilities. A bulk of the postwar foreign-refinery construction already scheduled covers projects in Venezuela. Also, several of the operating companies report that ultimate postwar plans call for significant additions to the projects which are now scheduled for what might be termed the war-transition period.

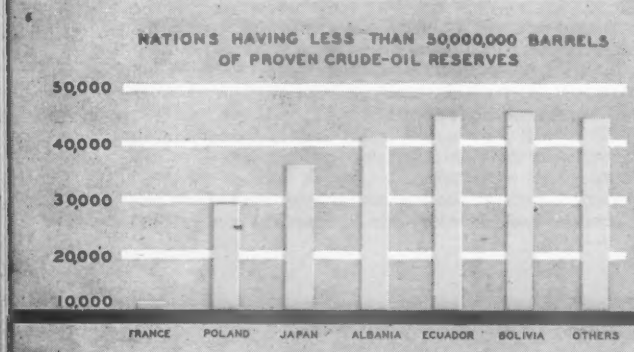
Central European and Asiatic reserves, partially because of their subjugation to destructive influences of military evacuation and subsequent occupation, will require intensified rehabilitation. Romanian fields, the most extensive and productive in Europe, doubtless were effectively destroyed as the German military machine was routed by Soviet troops. Practically nothing specific is known about the condition in which Soviet Russian forces found the Romanian petroleum facilities. The long-range program of Allied bombing coupled with demolition at the time Nazi forces retired probably reduced the fields to a minor fraction of their peacetime productivity. Reserves in most of the Romanian fields will be damaged or at least rendered recoverable only by longer operation because of the war interruptions.

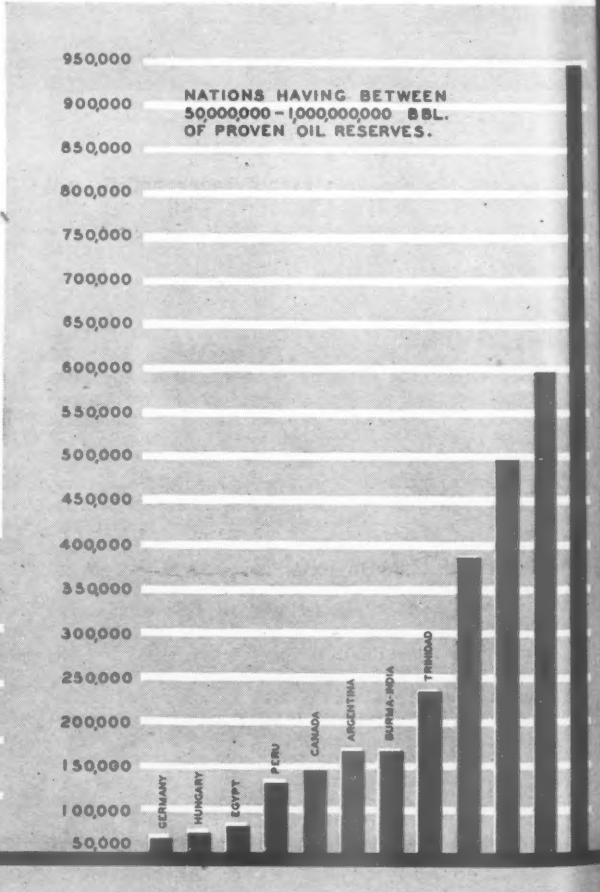
Parts of China have risen to more important position in the list of prospective oil-producing territory of Asia. Production is limited to one isolated operation in the province of Kansu. Seepages and other geological indications are reported in Sinkiang, Shensi and Szechwan provinces.

The scope of rehabilitation work in the Netherlands East Indies probably will be even more extensive than in European countries. The rich Asiatic market with its potentialities for expansion in the postwar era are so inviting that little time will be lost in returning top engineers and production men to Sumatra, Java and Borneo to start rehabilitation and reconstruction work when Japan is driven from present positions.

NATURAL GAS consumption in the early postwar years in the United States is chiefly dependent on three factors: (1) The degree of business and industrial activity in the nation, (2) gas pipe-line construction, rate of utilization of existing lines, and (3) the supply available from existing fields.

The degree of industrial activity with which consumer purchasing power is closely allied is best measured by the Federal Reserve index of industrial production, with the 1935-1939 activity taken as 100. Projections of this index for the postwar period have been made by C. L. Burrill, economist of the Standard Oil Co. (New Jersey), in connection with his survey of postwar petroleum demand. Natural-gas demand is most generally conformable to the Federal Reserve index because about 75 per cent of total demand is consumed for industrial



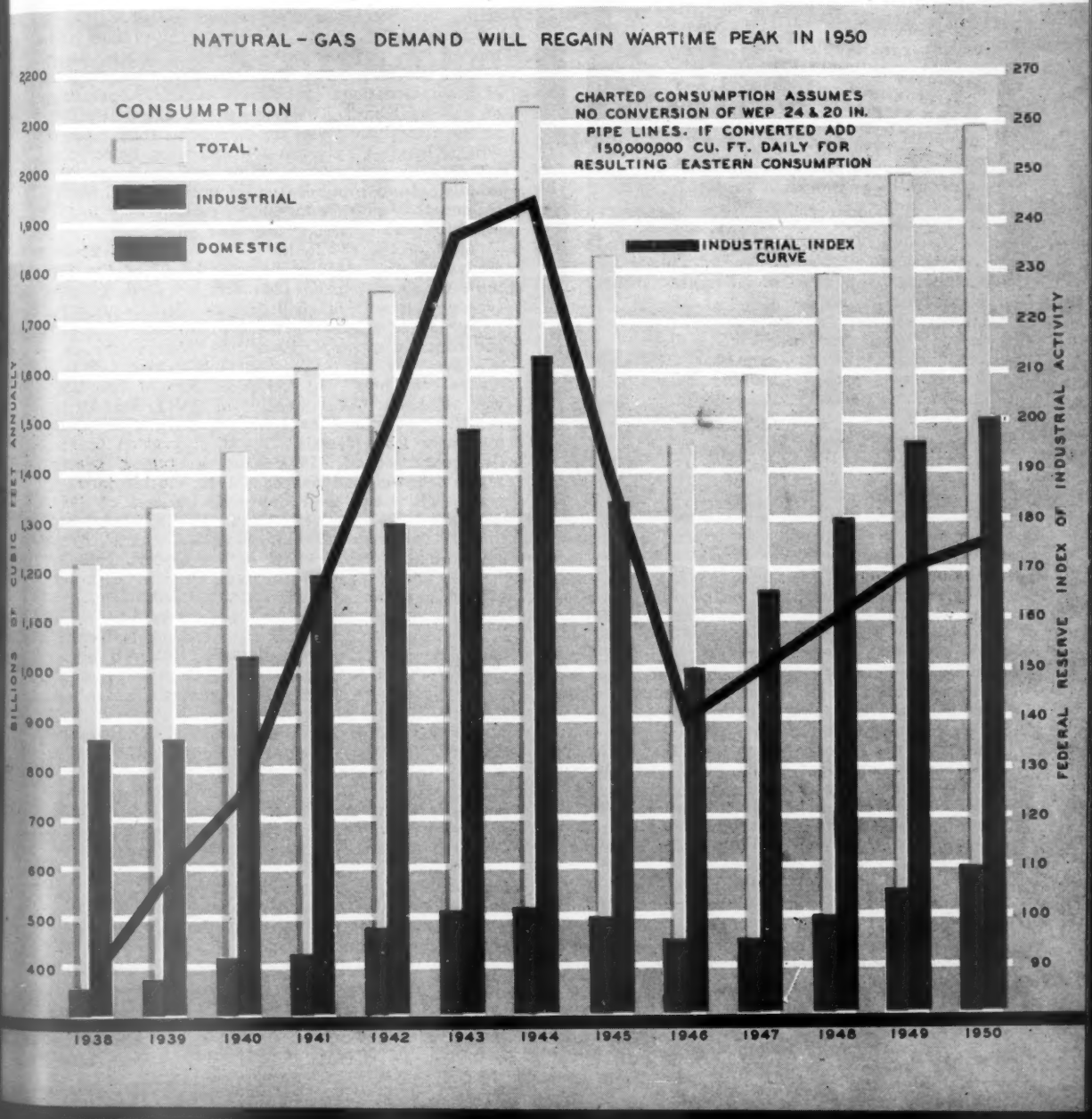


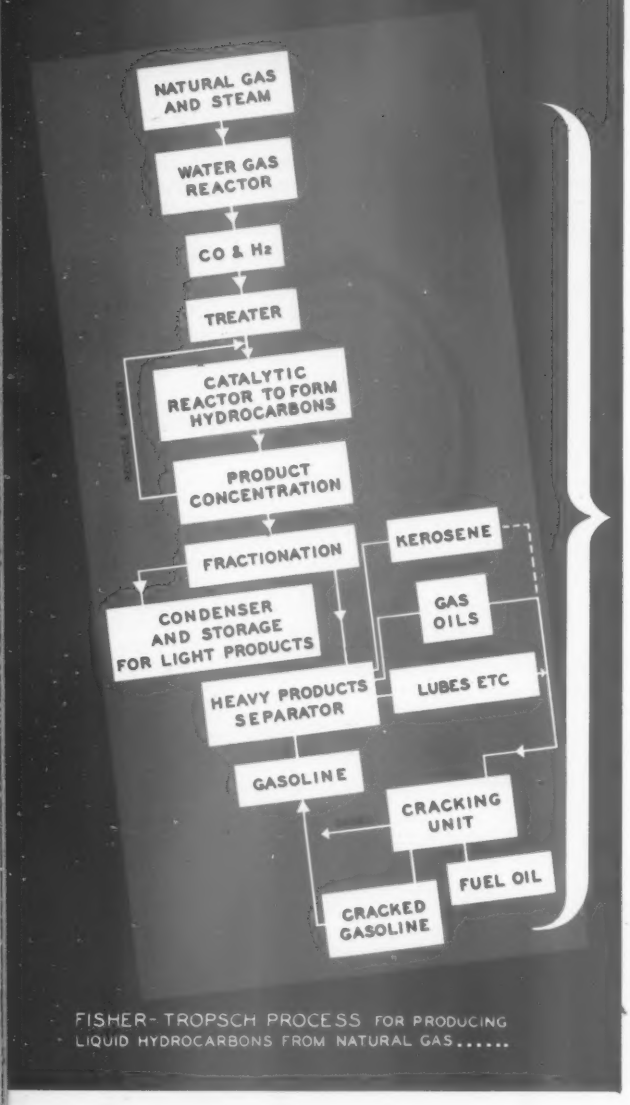
purposes. Fluctuations in demand are lessened and in a sense restricted from year to year within the limits of available pipe-line-transportation capacity.

Once pipe lines are built and natural gas finds its way into a new market it is usually there to stay. The efficiency of the fuel assures a ready outlet. This is mentioned to emphasize the importance of new pipe-line construction to future expansion of the industry, and to show that even in periods of declining business, demand for natural gas is likely to hold up relatively better than for other fuels.

Assuming adequate reserves and unrestricted pipe-line construction, the demand for natural gas would naturally continue a steady upward growth limited only by the degree of national prosperity. In compiling the estimates of future demand, no values have been assigned to possibilities of spectacular postwar expansion of consumer purchasing power which some anticipate.

Natural-gas consumption will be influenced by utilization through conversion of existing oil pipeline capacity and new gas-line construction scheduled in the postwar period to 1950. New construction, in turn, will be influenced not only by financial and economic conditions but by federal and state regulatory policies. Doubtless, construction will be influenced by new developments relative





FISHER-TROPSCH PROCESS FOR PRODUCING LIQUID HYDROCARBONS FROM NATURAL GAS.....

to the production of gasoline and petroleum chemical derivatives from natural gas, a phase of operations which undoubtedly has an important future. The marginal relationship between the value of natural gas as fuel and as a raw material for the production of liquid fuels and chemicals, may in future years have an important bearing on the directions in which the industry will expand between now and 1950.

Natural gas is conceded to be a more efficient fuel than its principal competitors, coal and oil. But interstate shipments of gas bring the industry under control of the federal Government, future expansion of the latter may be affected by public policy with respect to labor. It remains to be seen whether an attitude of government paternalism toward the coal industry will prevail, and if so, how far it will go, against the actual laws of economics.

Sufficient steel and money required to build entirely new natural-gas lines should become available by 1947, if the war ends before the close of 1945.

The problem of utilizing the big-inch and little big-inch oil lines extending from Texas to the East Coast in the postwar period is expected to come up for decision before long. Conversion of these lines to transmission of natural gas when tankers become available to move all the petroleum needed on the Atlantic seaboard seems to be generally favored, although there is some opposition, particularly from several of the large natural-gas-producing states. Disposition of the lines is speculatory but it can be seen that if converted to gas, the latter industry would receive pronounced postwar impetus.

TRANSPORTATION aspects of the postwar period have numerous clean-cut trends and some which will remain obscure until decisions are reached on what disposition to make of war emergency pipe lines and tankers. The postwar tanker fleet will substantially exceed the deep-water transportation requirements of the international petroleum industry, operating on a normal basis. There is scant doubt that much of the American coastwise petroleum traffic again will be handled by ocean-going tankers. Selectivity afforded by tankers in loading and discharge terminals permits minimization of transfers and transshipments of petroleum, adding considerably to the attractiveness of tanker transportation.

Most of the 630 tankers built in United States shipyards since 1938 and certainly all of the 586 built or started since 1940 are so-called defense type vessels with much higher speeds and substantially larger capacity. The combination of speed and capacity of modern wartime tankers—the vessels available for postwar marine transportation—makes each new boat the equivalent of two prewar tankships. Consequently, on prewar standards, the U. S. postwar tanker fleet alone will be equal to nearly 1,200 vessels. The U. S. prewar tanker fleet consisted of 416 vessels, averaging nearly 11,000 deadweight tons. Since 1940, the 586 tankers which will have been delivered by end of 1944 average 15,900 deadweight tons. Speeds of prewar tankers ranged from 9 to 11 knots compared to approximately 14-15 knots in the modern vessels. It is estimated that the average carrying capacity of each new tanker is about 140,000 bbl., compared with 100,000 bbl. for existing prewar tankers.

The present American tanker fleet is largely owned by the federal Government. Postwar operation of the fleet will, therefore, depend on government policy with respect to use or disposal of the vessels.

Another factor affecting the status of the present large fleet of government-owned United States tankers is the international aspect of fleet distribution, which in turn will rest on United Nations' postwar reconversion and reconstruction policies which have not yet been clearly outlined.

Great Britain, Norway, France, Belgium, Holland and even Italy are likely to be in the market for surplus U. S. vessels. However, this does not preclude much new tanker construction in the postwar period by those nations to rebuild fleets essential to inherent deficiencies of petroleum.

While there will be a tendency on the part of

everyone to prefer the new high-speed ships, many of the older and shallower-draft vessels will continue to be in demand for use in international trade for supplying the smaller ports of the world.

Legislation is now pending in Congress providing a formula for disposal of this surplus tonnage by the Government after the close of the war which is favored at least in some oil-industry circles. This legislation calls for the sale of the vessels at a base price of $135 per ton. It is estimated that the new, large tankers built during the past 2 years cost an average of between $190 to $200 a ton, but this includes military fittings which must be removed before the vessels are returned to private operation.

Record Tanker Construction

The record of new tanker construction in American shipyards marks one of the outstanding industrial achievements of the war. The largest tanker ever built was recently completed in an American yard. It has a carrying capacity of approximately 210,000 bbl. The production rate so far this year in American yards has been approximately 20 tankers per month.

AMERICAN OIL-TANKER CONSTRUCTION

	No. of tankers	Deadweight tons*	Average per tanker
1938	17	243,000	16,000
1939	12	193,112	16,093
1940	15	238,352	15,890
1941	32	434,039	13,564
1942	62	997,900	16,093
1943	252	4,055,436	16,093
1944 (estimated)	240	3,862,320	16,093
Total	630	10,024,159	15,900

Coastwise shipping is reserved exclusively for U. S. flag tankers. With full return of Gulf-East Coast petroleum traffic to the high seas in postwar years, it remains obvious that this country will have 400 to 500 tankers above minimum requirements and they may be expected to engage exclusively in foreign trade.

The indicated surplus of U. S. tanker capacity will be enlarged if the big-inch pipe lines are continued in petroleum transportation service similar to the function performed during the war.

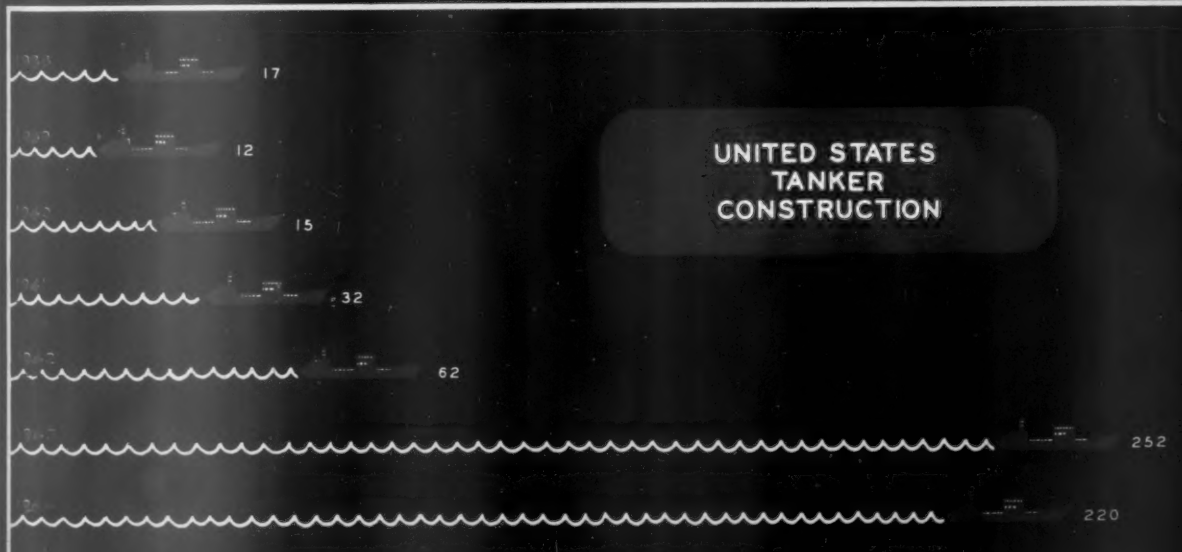
The unknown factor in the postwar tanker-transportation equation is national and international trade policies. Most current thinking envisages full utilization of U. S. marine facilities, including tankers, in world trade, under private management.

Transportation-Cost Outlook

Postwar tanker transportation costs are likely to fall below 1 mill per ton mile, based on the assumption that a minimum 20 per cent reduction will accrue from the efficiency factor which is nearly doubled in the modern tankship. Fixed charges will equalize perhaps midway between prewar and current levels, excluding wartime insurance. Higher costs in port charges and crew wages will prevent a straight mathematical reduction in transportation costs equal to improved efficiency. Prewar costs of transportation petroleum by ocean-going tankers were approximately 1.25 mills per ton mile compared to 3.2 mills via pipe lines and 8.3 mills by rail.

Inland waterway transportation is almost certain to retain its moderate wartime growth because of economies and the increasing shift of the center of crude-oil supplies away from interior refineries. Barge transportation is estimated in the range of 2 mills per ton mile, based on average costs along prewar routes.

Record demand projected by 1950 indicates that petroleum movement to the East Coast may push upward to around 1,600,000 bbl. daily compared to actual deliveries of 1,418,000 bbl. per day in December 1941. At the end of 1941, nearly 93 per cent of the East Coast deliveries were handled by tankers and most transportation executives expect approximately the prewar percentages to apply when the higher level of peacetime consumption is achieved.



Technical Progress Implements The

EXPLORATION operations must find 14 billion barrels of domestic oil by the end of 1950. That is the measure of the immediate postwar task as estimated by The Oil and Gas Journal, based on meeting the demand through 1950 and for building up proven reserves to 24 billion barrels at the end of that period. Twenty-four billion barrels would be in ratio to 13.8 to the anticipated production for 1950, and would therefore reestablish the 15-year relation that prevailed from 1929 through 1943.

To get the proper perspective on the size of this postwar task, the accumulated reserve discovery records were examined to find out how many years were required in the past to discover 14 billion barrels of domestic oil. The records show that between 1932-39, a 7-year period was required to discover 14 billion barrels; between 1933-40 another 7-year period was required; between 1934-40, 1935-41 and 1936-42, that discovery rate in 6 years was achieved three times. Therefore the postwar task does not call for any new record-breaking rates of discovery.

With the task outlined and the fact established that its achievement lies within the proven ability of the exploration branch, there remain the questions of:

1. What are the over-all plans, in terms of volume of activity?
2. Where is the new oil likely to be found?
3. What tools will be used in the search?

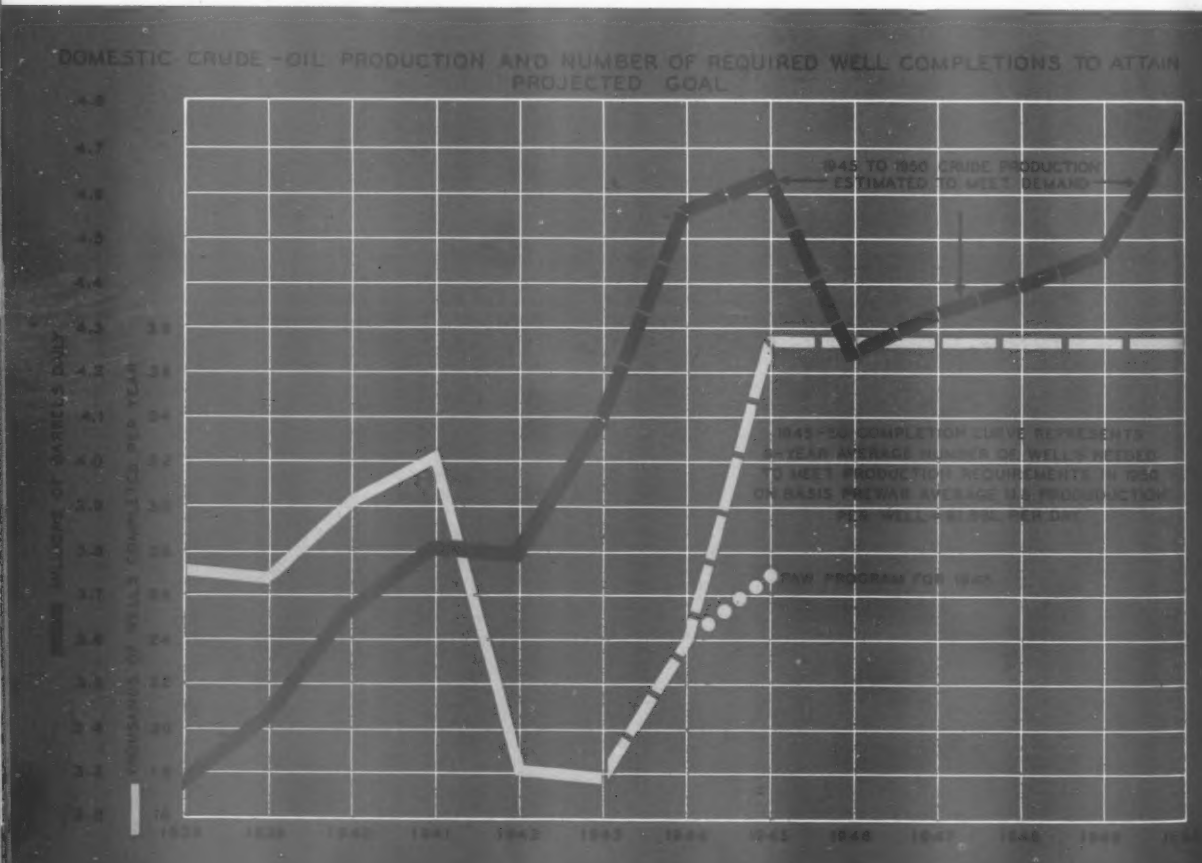
The men best qualified to answer these questions are the geological executives. They will supervise the preparations for the campaign, draw up the budgets and approve the plans to achieve the objectives. A cross-section of these executives was polled by the Journal, and their collective opinions are given in the composite questionnaire accompanying this analysis.

Briefly, wildcatting and exploration in the postwar period is expected to average about 8 per cent less than in 1944 for the United States, but substantially increase in foreign activity. Fifty-five per cent think there is a place in the postwar foreign-exploration field for the smaller integrated companies and the independent producers.

Reservoir Control Advanced

A substantial expansion is anticipated in practical applications of the theories of reservoir control. This opinion is also held by the manufacturers of specialized equipment for such work. Orders for such equipment are increasing steadily.

When it comes to Question 3, "What tools will be used in the search?" the problem becomes more complex. The answers come from many scientists and technical men. On one phase there is almost unanimous agreement neither "radar," nor any other


DOMESTIC CRUDE-OIL PRODUCTION AND NUMBER OF REQUIRED WELL COMPLETIONS TO ATTAIN PROJECTED GOAL
1945 TO 1950 CRUDE PRODUCTION ESTIMATED TO MEET DEMAND
1945-50 COMPLETION CURVE REPRESENTS 5-YEAR AVERAGE NUMBER OF WELLS NEEDED TO MEET PRODUCTION REQUIREMENTS IN 1950 ON BASIS POSTWAR AVERAGE OIL PRODUCTION PER WELL OF 10 BBL PER DAY
WAR PROGRAM FOR 1945
MILLIONS OF BARRELS DAILY
THOUSANDS OF WELLS DRILLED
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950

known tool developed for war use will have any spectacular part in finding new oil reserves. The war not only has not contributed any new tools that will be immediately available, it has retarded the normal development and improvement that could have been expected among the known prewar tools.

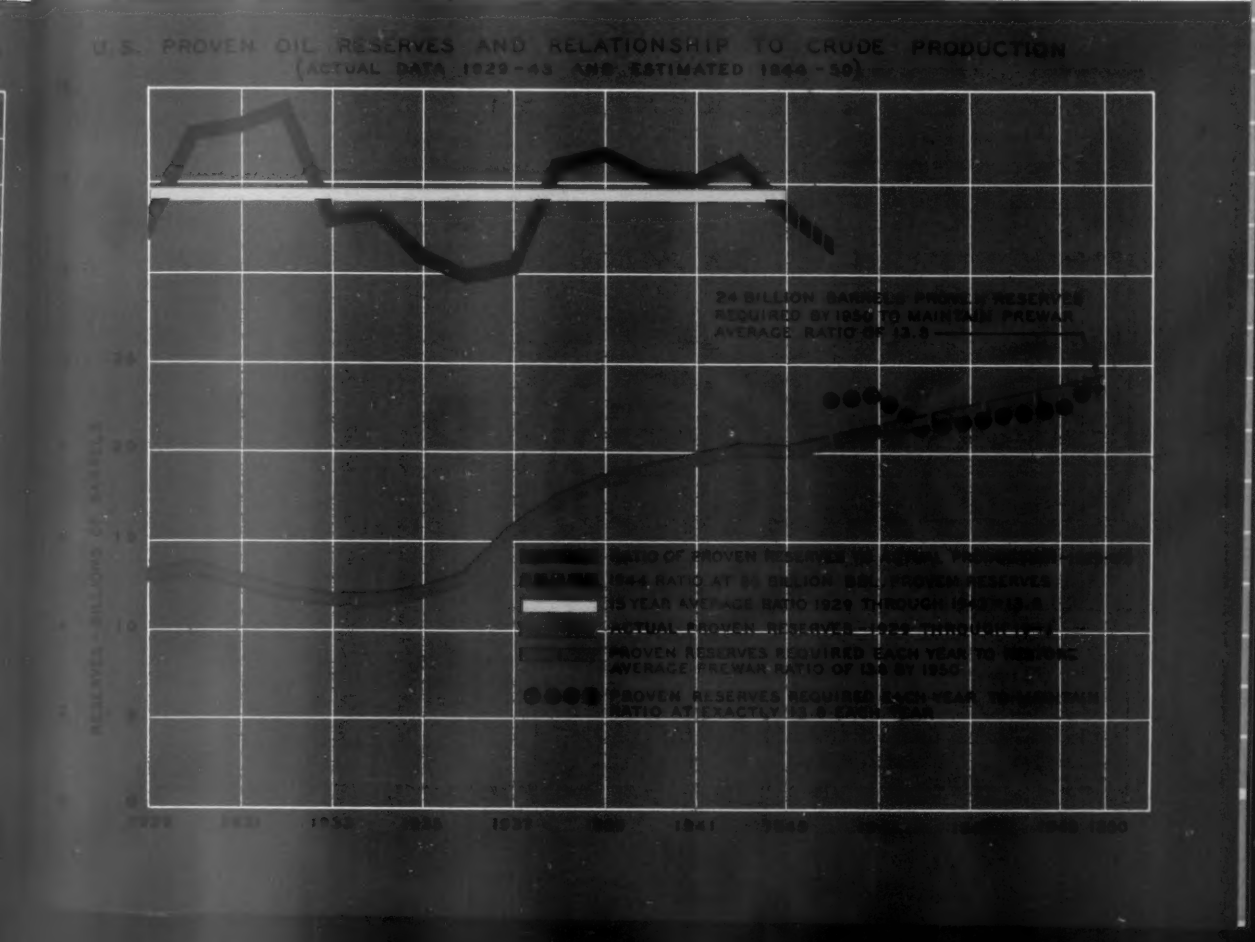
Use of geophysics will be expanded. The only question is whether the expansion will be greatly accelerated over the prewar rate, or will merely continue to expand at about the old rate. Geophysical data will be more closely and thoroughly correlated and integrated with all other available geological information. Aerial photography will come back after the war, but how extensively it will be used as compared to prewar, will depend on whether or not substantial reductions in unit cost can be achieved.

For the present and immediate postwar future, the geophysical instrument field seems to have narrowed. The gravimeter and reflection seismograph dominate the field with other instruments either gleaning the scraps or struggling to establish themselves. However, the field is wide open for any new instrument that can deliver equal or superior results at less cost.

The gravimeter dominates as a reconnaissance instrument, the seismograph as a detailing instrument with best results accomplished, in the opinion of their respective operators, when they are applied strictly to the field for which they are best suited. The trend toward using the rather expensive seismograph for more intensive detailing leaves a wide gap between this function and the generalized reconnaissance of gravimetric work. There is a constant temptation to stretch the work of the less expensive gravimeter into the intermediate territory between pure reconnaissance and true detail, with results that have not always been too satisfactory. The top seismograph and top gravimeter experts are equally insistent on defining and limiting the scope and type of work in which their respective instruments and interpretations will give the best results. In both fields, the emphasis is on the need for more and better work on interpreting the results of the existing instruments, rather than improved instrumentation. In both fields the war has retarded normal progress on these lines, primarily because the qualified manpower has been spread too thin.

The greatest potential means of reducing costs in gravimetric work lies in the expense of simple surface surveys. If any of the prewar work on the use of radio transits or other electrical surveying devices to speed up such work should develop gravimetric work might be reduced in cost rather substantially.

The seismograph is expensive but gets detailed


U.S. PROVEN OIL RESERVES AND RELATIONSHIP TO CRUDE PRODUCTION
(ACTUAL DATA 1929-43 AND ESTIMATED 1944-50)
24 BILLION BARRELS PROVEN RESERVES REQUIRED BY 1950 TO MAINTAIN PREWAR AVERAGE RATIO OF 13.8
PROVEN RESERVES REQUIRED EACH YEAR TO MAINTAIN AVERAGE PREWAR RATIO OF 13.8 BY 1950

results that are otherwise obtainable only by drilling. No substantial changes or improvements are in sight. The greatest need is improved interpretation which would be speeded up and aided by more combination geologist-geophysicists. Elimination of the drilling of shot holes would reduce costs substantially, but there seems no way of doing this without having the weathering effect dampen and dissipate the reflection waves. There is constant improvement in filters, but the major problem of eliminating ground noises runs into the obstacle that these have the same wave length as the reflections, hence too much filtering out of ground noises also results in filtering out the reflections that are sought. There are promising possibilities that developments in use of coaxial cables may at some postwar period eliminate the necessity of having a separate cable to each separate geophone.

There are three auxiliary logging tools that may find a larger place in the postwar exploration work. All three promise to give the geologist additional information about the formations penetrated by the bit. One is a mobile mud-logging unit which in addition to giving a continuous mud log on a drilling well also incorporates an oil and gas detecting device. It is claimed that this device will detect oil in concentrations of less than 10 parts per 1,000,000 in the mud fluid, and the presence of gas in quantities as little as 1/100 cu. ft. per hour released from the mud. The advantages of such information during the drilling of a wildcat are obvious.

Another is radioactive well logging, which had been just introduced when the war broke out. Obviously it may have a substantial field in reworking old areas, since accurate recordings are claimed through as many as four strings of pipe. It may be able to give more selective data on some of the thick lime pays where ordinary electric logging does not always give sufficiently selective information.

The third is an adaptation of the electric device originally used to pick points for selective acidization jobs. The new adaptation gives a direct recording which appears to correlate closely with the effective permeability of the section tested, and to be rather highly selective in thick sections.

The interest in stratigraphic traps has certainly been intensified by developments in the West Edmond field in Oklahoma. The trouble is that there is no royal geological road to simple and cheap finding of stratigraphic traps. There is some difference of opinion about the possibilities of seismograph success in locating stratigraphic traps; many feeling that while it cannot be depended on to locate the trap, the boundary can be outlined by this tool after the existence of the trap is determined. Still others agree that the boundaries of a newly discovered trap can be outlined but only under a limited set of conditions.

Intensified Study Essential

In general, however, opinion seems to be that a combination of every scrap of geological and geophysical evidence, plus intense study of this evidence, plus some imaginative thinking, plus a willingness to drill a lot of dry holes, plus some luck, is the only sound formula for locating such traps. Substantial thinking and research is being devoted to the possibilities of developing portable, cheap, extra slim-hole drilling rigs, but the problems of reaching below comparatively shallow depths with such an outfit are proving to be very difficult.

Postwar thinking about exploration policies is divided into two phases. For virgin territory, there seems general agreement that a comparatively quick over-all gravimetric reconnaissance followed by seismograph detail on the outstanding promising shots, plus a wildcatting campaign that hits only the choice seismograph prospects will produce the greatest return on the investment. In brief, in virgin territory, make a quick once over and test only the best looking shots. Reworking older areas calls for an entirely different policy. Here each new tool recreates to a limited extent a virgin territory within the whole but even when successful any single

SUMMARY OF JOURNAL SURVEY OF EXECUTIVE GEOLOGISTS' OPINIONS

1. Compared to 1941, what do you anticipate will be the trend of wildcatting and other exploratory activity?
   57.7% expect average drop of 19% —19%
   22.6% expect no change..... 0%
   19.7% expect av. increase of 14% +14%
2. What areas in the United States do you think will receive the most wildcatting?
   1. Mississippi; (2) West Texas; (3) Rocky Mountain; (4) Alabama and Georgia; (5) Texas Gulf; (6) Texas, South, Southwest; (7) Oklahoma; (8) New Mexico; (9) Kansas, and (10) Texas, Eastern
3. Do you anticipate substantially more foreign exploratory activity by U. S. companies?
   Yes—97% No—3%
4. Do you anticipate foreign activity by smaller integrated companies and by independent producers?
   Yes—55% No—45%
5. What foreign countries or general areas do you think will get the most active play?
   1. South America, principally Venezuela and Colombia; (2) Persian Gulf region; (3) East Indies, and (4) Canada.
6. Do you anticipate experiments in the practical application of reservoir-control theories to increase?
   Very rapidly—19% Rapidly—23%
   Moderately—58%
7. Do you anticipate any material shift in emphasis among the various exploration methods now used?
   74% expect no material shift, or a very slowly developing shift.
   26% expect increased use of seismograph, gravimeter and aerial photography.
8. Do you anticipate any marked developments in instrumentation or operating techniques from war developments?
   No—77% Yes—23%

new tool quickly exhausts its major possibilities in reworking older areas. Taking advantage of every scrap of information revealed by past development of the area, then adding all the knowledge gained by developments in all branches of exploration work since the area was first developed, plus the use of all new oil-finding tools brought into use since the area was first drilled, and careful correlation of the new evidence with the old, is the formula offered for best results.

The trouble with the formula for reworking older areas is that under present circumstances accumulation of all of these data and use of all of the new tools is usually feasible only for the major companies which have most of the required special services available on a salary basis. The independent producer must seek many of these services from separate consulting groups, each specializing in only one or at most two or three of these services. Sold on a separate basis, the complete service suggested is often too expensive for the smaller producer to use in testing ideas he may have about possible shots in reworking older areas. There is some thinking along the lines of developing a consulting clinic, somewhat analogous to the medical clinic idea, wherein the overhead and sales promotion cost might be reduced, and where the cost of accumulation of basic regional data, once acquired, could be spread over the sale of joint services to many individual producers.

To summarize briefly, the conclusions seem to be that the volume of domestic exploratory activity will decline slightly from the all-time high level of 1944, but that the quality can be expected to increase. The increase in quality will come partly from more extensive use of tools known in the prewar period, but mainly from the improved interpretation of the results of the known tools. This improved interpretation will be largely due to the greater availability of technically trained manpower.

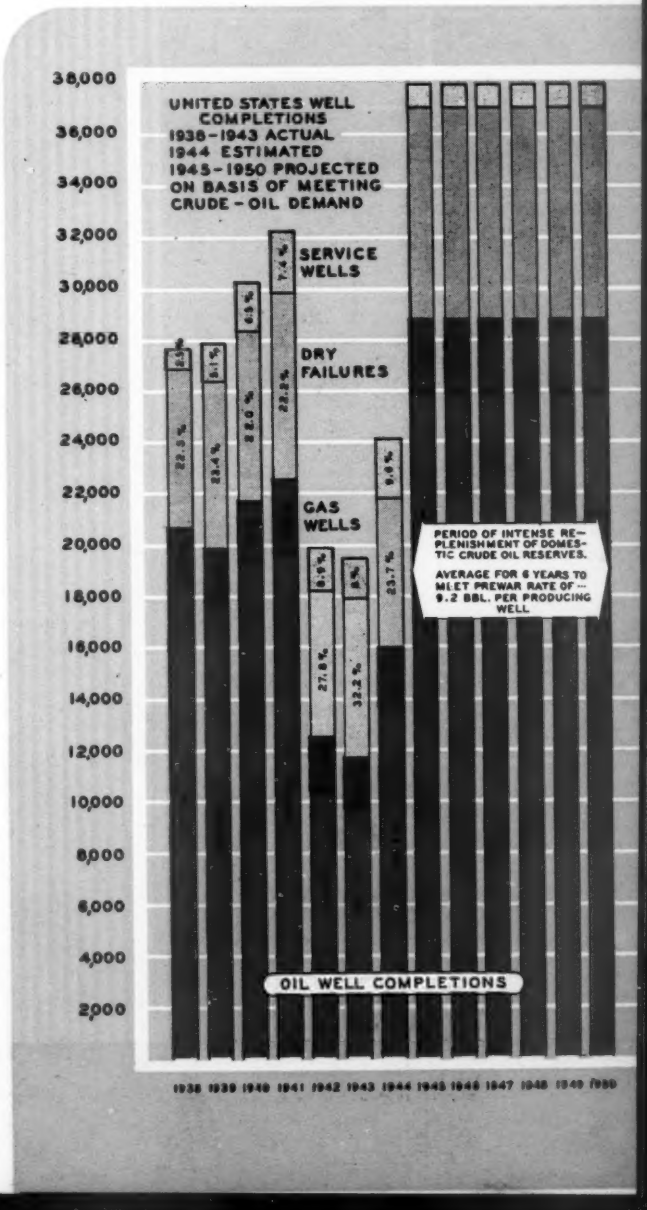
Foreign exploratory activity will probably increase substantially, primarily in Venezuela and Colombia, next in the Persian Gulf region, third in the East Indies and fourth in Canada.

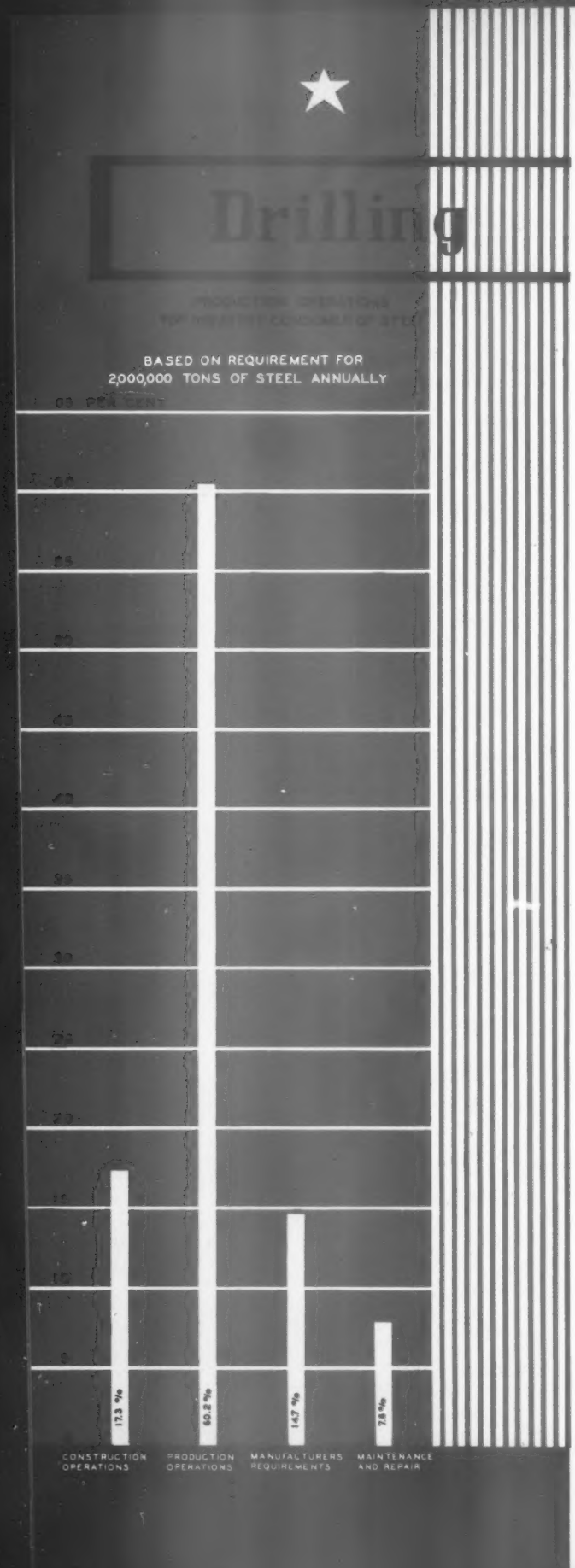
The task of replenishing the domestic proven reserves of crude oil is essentially an economic function as long as supply, demand and price exert normal influence. Over a 15-year period it seems to have been established that proven reserves will fluctuate around a ratio of 13.8 to the annual production. Above that point, exploration tends to be depressed, below that point exploration increases. Prospective record production, of course, demands prompt, intensive and productive exploration.

DRILLING equipment and techniques during the postwar period will reflect present trends toward more effective and efficient operation.

Principal improvements in general rig design and assembly will provide for increased capacities and power with greatly reduced weights and sizes. Greater attention will be paid to proper utilization, transmission and adaptation of power to loads and needs. New practices will give maximum assurance of safety, elimination or overcoming of hazards as now known and successful completion of wells. Extended use of the auxiliary aids and services for logging and identification of formation characteristics and content and for control of drilling will materially expedite exploration and proving of additional petroleum reserves.

Equipment capable of handling loads and meeting the problems imposed by drilling to depths of 15,000 to 18,000 ft. will be made available. In regions such as the Gulf Coast and California where thickness of sedimentary accumulations permit, exploitation of horizons at these depths is certain to spread. With facilities to be provided and adaptable technique, deep drilling will be conducted with the same degree of ease and safety as normal wells now are completed at depths of 10,000 to 12,000 ft. Rigs which can go to at least 15,000 ft. already are in use as is evidenced by the successful completion of several holes to that





depth within recent years. General drilling to such depths, however, will occasion the use of larger-capacity facilities.

In the past, increased capacity and power usually has been attained by greater size and weight, adding materially to costs and increasing the problems of assembly and transportation. With practical and economical limits in this direction about reached, manufacturers of equipment and operators have directed their efforts toward reduction of weights and sizes. These objectives will be realized through developments in metallurgy and utilization of lighter metals which can be alloyed to suitable strength, and by improved equipment design and better rig balance.

With lighter weights and smaller sizes, it will be possible to unitize and standardize rigs to a higher degree and increase their portability. Emphasis will be placed upon compactness in assembly and convenience in setting up and tearing down, and in operation.

Mechanical power and direct-current electric rigs will supplant steam equipment to a greater extent in all localities where cheap fuel and good water are not factors. Limitations of the internal combustion engine, direct drive rigs in high starting torque, and flexibility and smoothness of speed changes necessary for handling the greater loads of deeper drilling will be overcome to a large extent by perfection and more extensive application of torque converters and hydraulic drives and by improvements in mechanical transmission of power.

Electric Rigs Gaining Prominence

Especially for ultra deep drilling, where cheap fuel and abundant good water are not available, direct-current electric rigs will become increasingly common. These will employ internal combustion engines, mostly diesels, for power generation. The deeper-drilling rigs will have from 1,000 to 2,000 hp. Diesel engines, supercharged to deliver 600 hp. and weighing only 25 lb. per horsepower, are now being made for war use and will be adaptable for rig service after the war. Direct-current rigs will be characterized by simpler control, improved design and larger prime-mover horsepower. The problem of proper maintenance and supervision of diesel engines and electrical equipment, now a major handicap to use of these rigs, will be overcome by the release from military service after the war of many men specially trained in this work. Providing the flexibility and smoothness of steam power, electric rigs may become a strong competitor to direct-drive, internal-combustion-engine rigs on deep drilling.

Need of jack and line shafts is being eliminated on direct-drive power rigs by making speed changes for the draw works in oil-bath housing on short centers. This is a factor in reducing weights, size and costs. Although it will be necessary to have a cathead shaft, this need will not be any larger than required for the actual power utilized in catheading. This feature no doubt will be extended to steam and electric rigs. Speed changes on power rigs will be by means of air or vacuum or electronic control, supplanting manual control. The control will provide for automatic speed selection and clutch-shift interlocking, which will make operation foolproof and reduce the hazard of damage to equipment and minimize maintenance requirements. Similarly, vacuum or air controls will

operate drum clutches, lightening the work of drillers.

Magnetic or electrical braking for draw works or hoists will be developed to the point which will reduce the weight required for auxiliary brakes. Diameters of drum centers will be increased which will improve wire-rope performance and shorten the distance between bearing centers.

Use of automatic feeds for drill pipe will insure more accurate control of weight on bits and at the same time relieve the driller. More effective utilization of engine power will be attained by automatic synchronization of engine speeds, which will be done by electronic or vacuum or air control of fuel feeds and torque. Through synchronization, each engine will carry its proportionate share of loads, eliminating overloads and underloads. Greater efficiency in operation of direct-drive internal combustion engine rigs will be attained by more effective distribution of power. Prospective changes involve decentralization of power, distributing the work among more engines and coordinating engine sizes with power requirements.

Applications of independent rotary drives will be extended, particularly on the deeper drilling rigs. Developments in the use of torque converters and hydraulic drives will eliminate some of the problems of independent rotary drives where internal combustion engines are employed, and thus make possible smoother changes and a wider range of speeds than available with present mechanical transmission units. On steam rigs use will be made not only of steam-engine drives but also electric-motor drives with direct-current power supplied by portable steam-turbine generator units.

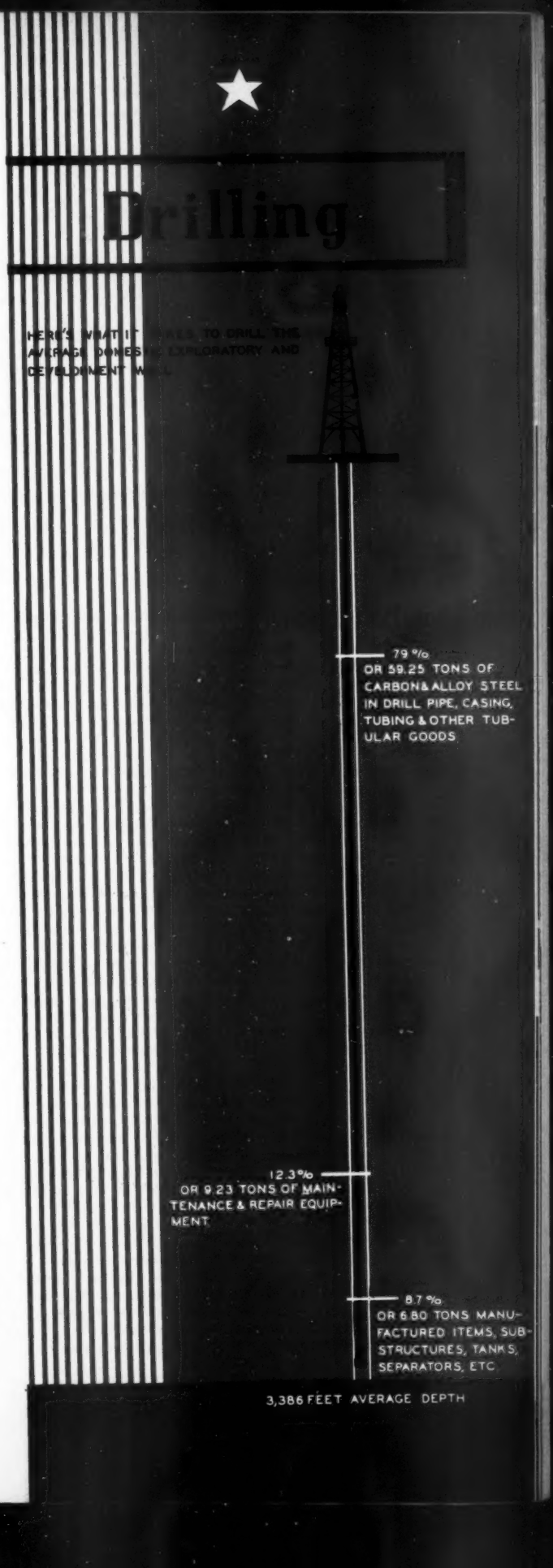
Experiments now being made in the use of collars instead of tool joints for making up drill pipe will lead to wider adaptation of this practice, although the need of tool joints will not be eliminated for most work. Use of collars is being made possible by improvements in metallurgy and design.

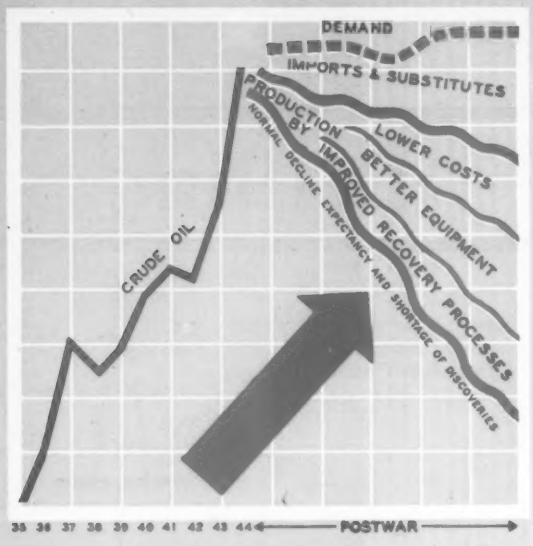
Collapsible Bits to Be Developed

Collapsible bits which can be run in the hole and retrieved by wire line will be made more practical and will find increasing use. It also is entirely probable that independently operated bits, driven by fluid pressure, will be developed. Such bits, with a turbine head and a long drill collar for weight, would be operated on a cable, on which also would be supported a hose-type tubing for transmission of the fluid pressure from the surface to the bit.

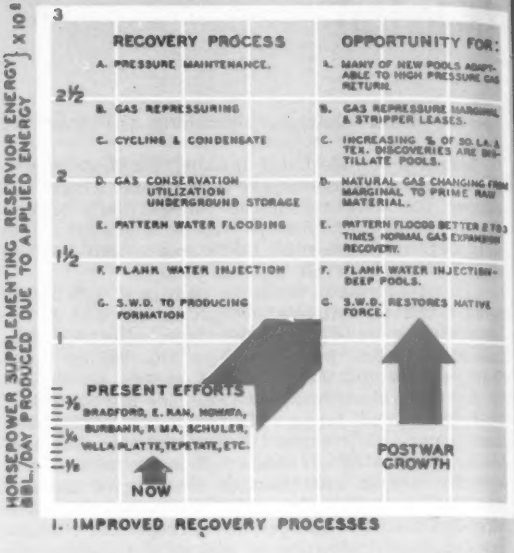
Drilling will become more scientific with increasing use being made of instruments and other mechanical and electrical means for logging and identification of formations and detection of oil and gas accumulations. The trend toward elimination of the human factor will continue. Emphasis will be placed on automatic recording and control of various phases of operation. Automatic control also may be extended to maintenance of desired mud characteristics with increased reliance being placed upon proper treatment and conditioning.

With more adaptable and lighter equipment, drilling will become more efficient. Improved bits will permit more hole per run and faster time. Ability of rigs to handle loads quickly will permit faster trips. Control of wells will be more certain. Everything will combine to reduce well time and minimize costs of drilling.


Drilling
HERE'S WHAT IT
AVERAGE DONES
DEVELOPMENT W
TO DRILL THE
EXPLORATORY AND
79 %
OR 59.25 TONS OF CARBON & ALLOY STEEL IN DRILL PIPE, CASING, TUBING & OTHER TUBULAR GOODS
12.3%
OR 9.23 TONS OF MAINTENANCE & REPAIR EQUIPMENT
8.7 %
OR 6.80 TONS MANUFACTURED ITEMS, SUBSTRUCTURES, TANKS, SEPARATORS, ETC
3,386 FEET AVERAGE DEPTH



THE JOB


HORSEPOWER SUPPLEMENTING RESERVOIR ENERGY } X 10⁸
BBL./DAY PRODUCED DUE TO APPLIED ENERGY
3
2½
2
1½
1
RECOVERY PROCESS
A. PRESSURE MAINTENANCE.
B. GAS REPRESSURING
C. CYCLING & CONDENSATE
D. GAS CONSERVATION UTILIZATION UNDERGROUND STORAGE
E. PATTERN WATER FLOODING
F. FLANK WATER INJECTION
G. S.W.D. TO PRODUCING FORMATION
OPPORTUNITY FOR:
A. MANY OF NEW POOLS ADAPTABLE TO HIGH PRESSURE GAS RETURN.
B. GAS REPRESSURE MARGINAL & STRIPPER LEASES.
C. INCREASING % OF SO. LA & TEX. DISCOVERIES ARE BIOLITE POOLS.
D. NATURAL GAS CHANGING FROM MARGINAL TO PRIME RAW MATERIAL.
E. PATTERN FLOODS BETTER 2 TO 3 TIMES NORMAL GAS EXPANSION RECOVERY.
F. FLANK WATER INJECTION-DEEP POOLS.
G. S.W.D. RESTORES NATIVE FORCE.
PRESENT EFFORTS
BRADFORD, E. KAN, NOWATA, BURBANK, R MA, SCHULER, VILLA PLATTE, TEPETATE, ETC.
NOW
POSTWAR GROWTH
SERVICE LIFE PER REPLACEMENT
CAPACITY PER UNIT INSTALLATION
UNITS: BBL. X 10⁸ YEARS, ETC.

1. IMPROVED RECOVERY PROCESSES

THE

PRODUCTION of oil and gas is on a threshold different at this point than that existing for most other industries engaged in war operations. In petroleum production, there are thousands of things left by the war to be done; there are many opportunities left but little touched. The backlog of needed facilities, postponed equipment, past-due machinery, justified modernization, is tremendous. The surface is but scratched. The production division is way behind and has a big job cut out for the postwar era.

The present status does not arise from the industry and there is no blame or fault finding attached. Crude oil and natural gas are wartime "musts" and the military demands are being fulfilled. Current production rates are record breaking. To achieve these rates, though, short cuts had to be made, substitutes used, and supplementary recovery facilities deferred. Worn and obsolete equipment had to do the work, temporary expediencies prevailed. Junk piles have been recombed time and again. Many new small pools had to be scantily developed, meagerly equipped and such things as gas return and pressure maintenance possibilities often had to wait. Wartime development has one principal objective—get the oil!

The Job Ahead

The postwar production job will be to close the gap between what would be the normal expectancy for oil and gas yields under natural conditions and continuing ordinary procedures, and this future, unceasing, high-level demand. The size of this apparent gap is not subject to the most precise mathematical computation. For the first few months, a year or so, it may be rather minor, even nonexistent if a purely short-term examination is made. Yet down the line, year by year, is Kansas in shape to yield 275,000 bbl. per day? Oklahoma for about 325,000? California for the order of 750,000? How much for Illinois, Michigan, the Penn Grade area? The Rocky Mountain region? Will they hold their part of the line? Most of the flush fields are in Texas, Louisiana, Arkansas, Mississippi. Can these more prolific wells continue the pace with just the usual efforts and last year's practices? With time, the gap will broaden, the job be much bigger.

The problem is not single-issued nor independent of other factors. Normal decline and lessening of new discoveries is on one side. On the top side of the gap is the alternative of large increases in imports, and the advent of substitutes. The job is to narrow and close the future gap, as expressed in the accompanying chart.

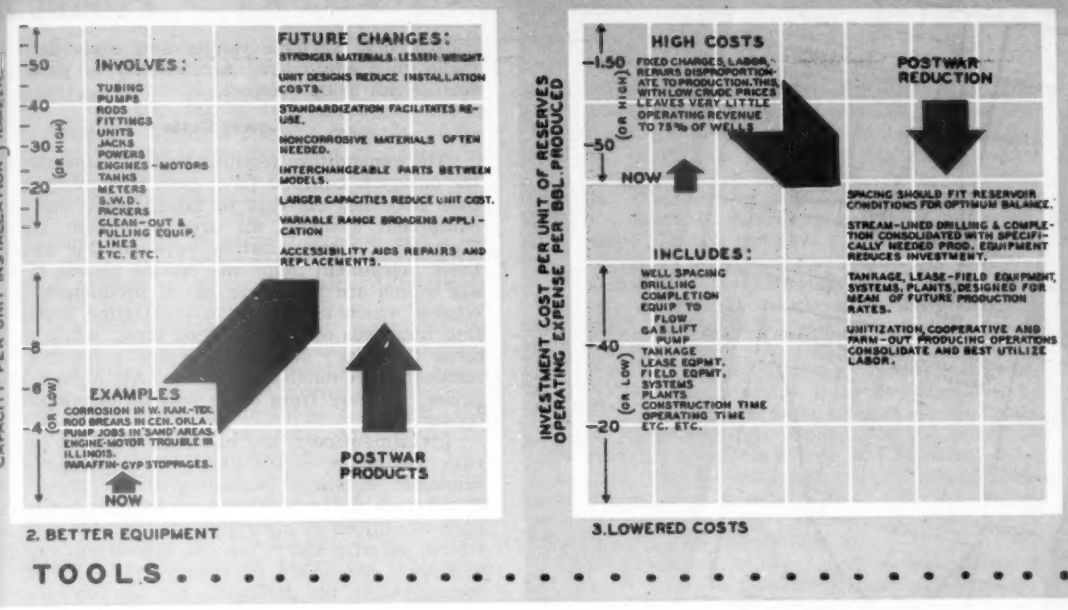
The Tools Available

The tools to be used in meeting the high postwar demand for crude and natural gas from established reserves fall into three main headings: (1) Improved recovery processes; (2) better producing equipment, and (3) lowered costs. Actually, if effective, the three are related and nonseparable, and reach a common denominator in the phase, "more oil extracted at lesser unit costs."

The future trend in large part will be on improved recovery processes. These will deal chiefly with methods that involve supplementation of natural reservoir energy to pools and leases which are deficient in that most important recovery force. The processes basically are well known; they need wider application, more intensification, new designs in layout and installation so that they can do work they have not done to date.

Bradford has been the record maker in intensive flooding, but there is much left undone. Illinois so far has only one pattern-flood more than 1,000 ft. deep, yet that is proving very profitable. Kansas floods generally are less than 1,000 ft., yet four current operations at 2,000 ft. are the most profitable of all. Oklahoma has virtually no floods outside Nowata, yet that area was relatively lean in primary recovery, and the best pools of the past are not now being flooded.

Gas repressuring has established a fine record at KMA in North Texas, to mention but one ac-



tivity out of many in that line. But are the majority of the hundreds of such semiflush and stripper fields receiving similar treatment?

Gas cap drives can recover millions of additional barrels of oil often at less cost than by new exploration. High pressure practices have been developed and proven at Tepetate and Ville Platte. These pools are deep. The technology fits the reservoir conditions and the different economic complexities brought on at 10,000 ft. With depth, high-pressure-gas return will fit more and more into the recovery picture.

Cycling plants currently total 35 in number. There are four building and also more than a half-dozen projects under active consideration. By end of 1944, cycling plants will be handling approximately 3 billion cu. ft. of gas and extracting 100,000 bbl. of liquid products per day. The future prospects may be judged by the fact that during 1943 the frequency of finding gas condensate fields in South Arkansas, Louisiana, and the Texas Coast increased to 36 per cent of all discoveries.

Flank injection of extraneous water is a brand new recovery technique. At the Midway pool in Arkansas, 1½ years of operation have given the expected pressure arrestation, producing rates are being easily maintained, and the data indicate much greater oil recovery will result. Salt water return to the productive formation, a somewhat kindred practice, also is growing rapidly in practically every producing area.

Multizone completions are here to stay. The practice is growing rapidly in Texas and many have been made this year. Kansas, Illinois, California, and other multipay areas will receive more dual completions. Some designs incorporate nonintermingling and make possible the obtainment of separate bottom-hole pressures. The newer cementing and perforating tools and procedures will assist in completions. Liners, screens, gravel and permeable cement packs, water-shutoff methods, etc., will be more frequently employed, with specific and determined factors setting their use.

Better equipment is used here first in speaking of the 420,000-odd U.S. wells, most of which already have been on production for a considerable number of years. Only 12 per cent of the total are flowing wells. The wells in the heavy water areas of some places in Illinois, Western Kansas, Oklahoma, West Texas, New Mexico, etc., can produce relatively large quantities of oil. However, for many this also will mean the production of much water, perhaps ultimately on the order of nearly a million barrels each. The majority will need more equipment, and better equipment, to finish the job. New pumping units, central powers, tankage, etc., are required. All over the country there are numerous stripper leases with substantial reserves, good for 20, 30, 40 or more years. Quite often, though, the equipment is old, misaligned, has frequent breakdowns, and may be dangerous. Corrosive gases and water in scores of pools are constantly eating away the present equipment by the ton. Wells in this class will have numerous future requirements to close their part of the "gap."

Better Equipment Must Offset Depth

The other part here, for better equipment, applies to the 6,000 to 10,000-ft. wells of yesterday and today, and the 10,000 to 15,000-ft. plus wells that are coming. These, in the West Texas Ellenburger, the deep Texas-Louisiana coastal zones, Oklahoma's Anadarko basin, in Wyoming, California, and elsewhere, cost $100,000 to $300,000 to drill and complete. Their future life will be anywhere from 10 to 75 or 100 years. The well completion must rely upon good producing equipment to establish a future history that will satisfy the investment and return a profit. As a minimum, 10,000 wells per year will go on the pump, and 15,000 may only be on the upside of the range. The best of steels, bearings, chains, gears, rods, pumps, and specific heavy-duty designs will be needed for the coming deeper wells.

Lessened weights and stronger materials are paramount in good design. More unitization in

construction, variable ranges and capacities, help make good equipment. Accessibility of parts is a feature not to be overlooked.

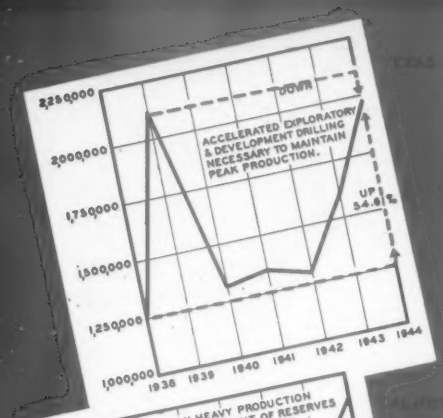
Lower Costs

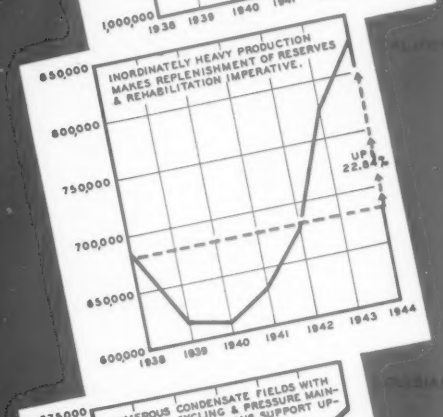
The expenditure required to drill a specific well, the outlay to equip to flow, gas-lift or pump, as the case may be, the cost to install lease and plant equipment systems, all are investment charges. There is a direct relation between the whole of these investment items and certain classes of acreage which are known to be oil productive. These classes, which altogether in the United States run into hundreds of thousands of acres, while in one sense "proven", still do not now constitute economically producible reserves. At higher crude prices, reserves from these will be developed and conserved.

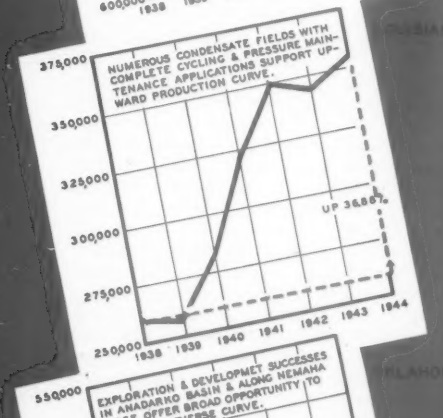
Investment costs are not something set by law, rule, regulation, or the like, or even altogether by economic situations prevailing at any given time. Depths are not wholly the controlling factor, nor such conditions as hard digging, troubles with corrosion, paraffin and so on. The investment cost prevailing is not solely or largely controlled by the managements, the geologists, nor the contractors.

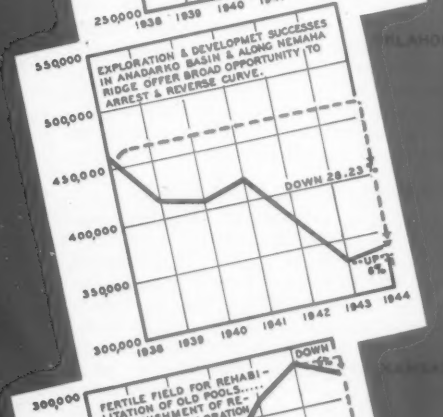
The most important control is by the production engineers and the people who analyze, report, and set the specifications in development, equipment, in production practices. How is this? It is in determining the optimum well spacing, in using the right kind of drilling, in neither overequipping or underequipping wells, in installing systems, plants, facilities, only when they provide an essential service and yield a profit. This clearly is engineering work, and it can be mediocre, fair, or the best. For any one given set of conditions, the first can bring about inordinately high investment costs per unit of reserves and rates; the latter can find ways for reductions and aid materially in closing the future "gap" and doing the job outlined here.

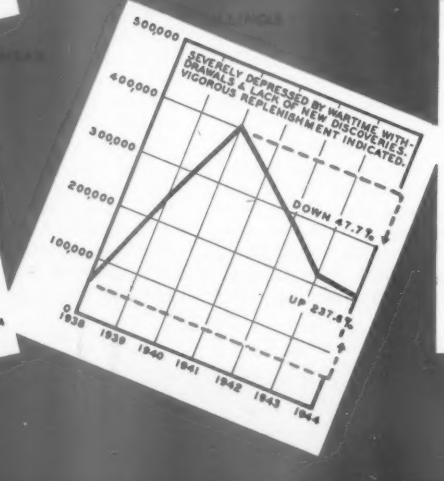
What about operating expenses? There are currently in the United States only some 45,000 flowing wells against 375,000 others on artificial lift, principally pumping. For the latter, many are very marginal, and a great number actually in the red. For all these, what makes up the operating expenses? Subsurface and surface repairs, replacements; fuel, water, supplies; labor, supervision. Any and all of these can be reduced with intensive effort, changes, and new thinking.

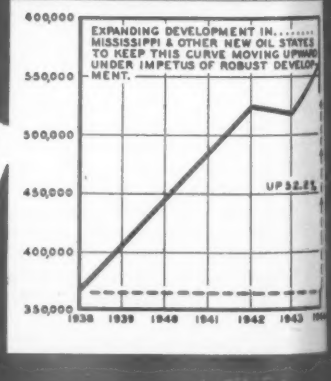












REFINING process developments during the war and in the immediate prewar period point the trend in postwar methods, in the opinion of refining executives and technologists. All processes accentuate the trend toward production of specialized materials, including individual hydrocarbons. Catalytic cracking overshadows all other processes, both in actual operation and prospective charging capacity and in its comparative effect on refiners' postwar economics. Alkylation's position in future refining operations is less assured, but will assume increasing importance as time goes on. The same statement applies to isomerization methods, with good prospects for its application to mixed low-grade hydrocarbon fractions. Various other synthetic methods for fuels will move to the fore, their prospects and trends too indefinite now to permit estimates.

The total crude refining capacity of all operating U. S. refineries, as of January 1, 1944, is given as 4,978,000 bbl. per day. Cracked gasoline production capacity is reported as 1,254,000 bbl. daily, equivalent probably to 2,500,000 bbl. daily gas-oil charging capacity, presumably including both thermal and catalytic facilities. The catalytic gas-oil charging capacity is 1,000,000 bbl. per day for aviation and motor fuels. Barnard and Forrester (N.G.A.A., Dallas, April 1944) believe this capacity will produce up to 450,000 bbl. per day of aviation gasoline and motor fuels, of which probably 50,000 bbl. per day will be military superfuels and an equal amount will be of lower octane rating, for commercial-plane consumption. These observers expect a catalytic cracking capacity increase within a few-year period to 2,000,000 bbl. charge per day.

Prewar motor and aviation-fuel production amounted to about 1,700,000 bbl. per day. It is estimated that a figure approaching 2,000,000 bbl. per day of motor and aviation fuels will obtain early in the postwar period. It may be expected that half of the future motor fuel will be catalytically cracked.

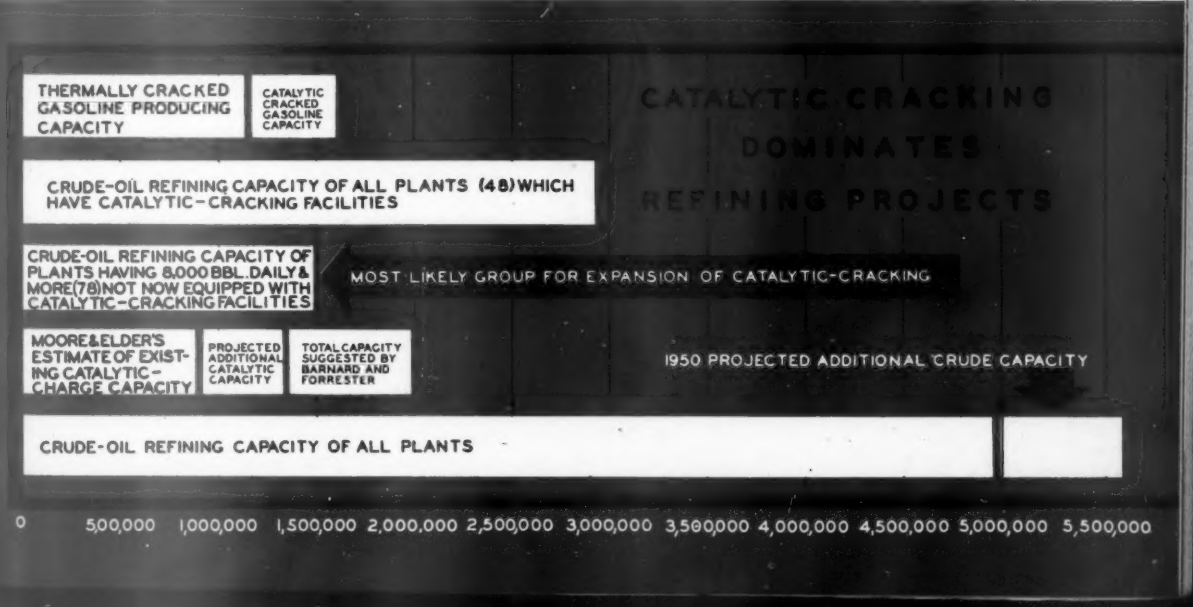
A survey shows crude capacity of 2,941,000 bbl. daily existing at refineries which now operate catalytic cracking facilities. Assuming that the smallest refinery which could operate a catalytic cracking unit successfully is one processing 8,000 bbl. daily or more of crude, there are 78 such refineries in the United States. These 78 plants report 1,506,000 bbl. daily crude capacity and 293,000 bbl. per day of thermally cracked gasoline producing capacity. Any conceivable portion of this capacity, which may mean twice the charge capacity in the gas oil, or 587,000 bbl. daily for either type process, may be converted or displaced by catalytic cracking. Assuming that half of it will be displaced within the first 2 or 3 years postwar, the prospects indicate nearly 300,000 bbl. daily of gas oil charge capacity installed at catalytic cracking units. For the 78 refineries, a catalytic cracking unit averaging 3,750 bbl. per day of gas-oil charge is indicated.

If the 1,506,000 bbl. of crude capacity represented by these 78 refineries is to be processed by catalytic methods in the same ratio as are the 2,941,000 bbl. daily of crude capacity in the refineries now having "cat crackers," or 30.3 per cent, these plants can absorb 456,000 bbl. per day of additional catalytic capacity, making a total within some assumed time period of 1,450,000 bbl. per day of catalytic cracking charge capacity.

Complementary to the 1 million barrel charge capacity in catalytic cracking is approximately 160,000 bbl. per calendar day of alkylate from two types of alkylation processes. Sulfuric acid processes include 108,000 bbl. daily of alkylate. Hydrofluoric acid (HF) units have total alkylate capacity of 52,000 bbl. daily.

Official PAW figures give current isomerization capacity as 35,000 bbl. of isomerized product per day, which may mean about 50,000 bbl. daily of charge capacity, most of it obviously being butane charge. Tied directly to alkylation now, much of this capacity can be easily converted to treating mixtures of hydrocarbons, naphthas, if desired, postwar.

Catalytic cracking can produce more of the light ends—propane, propylene, the several butanes and butenes—than does thermal cracking, with the possible exception of olefins. Data vary over rather wide limits. Figures available show that excess catalytic butanes are 6.5 per cent of the gas-oil charge, while in thermal cracking the excess butane fraction is 4 per cent. Or, calculated on another basis, with a 43.5 per cent yield of 10-lb. R.v.p. motor gasoline from catalytic cracking and 61 per cent of thermally cracked gasoline from the same crude, the excess butanes produced over and above


THERMALLY CRACKED GASOLINE PRODUCING CAPACITY
CATALYTIC CRACKED GASOLINE CAPACITY
CATALYTIC CRACKING DOMINATES REFINING PROJECTS
CRUDE-OIL REFINING CAPACITY OF ALL PLANTS (48) WHICH HAVE CATALYTIC-CRACKING FACILITIES
CRUDE-OIL REFINING CAPACITY OF PLANTS HAVING 8,000 BBL. DAILY & MORE (78) NOT NOW EQUIPPED WITH CATALYTIC-CRACKING FACILITIES
MOST LIKELY GROUP FOR EXPANSION OF CATALYTIC-CRACKING
MOORE & ELDER'S ESTIMATE OF EXISTING CATALYTIC-CHARGE CAPACITY
PROJECTED ADDITIONAL CATALYTIC CAPACITY
TOTAL CAPACITY SUGGESTED BY BARNARD AND FORRESTER
1950 PROJECTED ADDITIONAL CRUDE CAPACITY
CRUDE-OIL REFINING CAPACITY OF ALL PLANTS
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
3,500,000
4,000,000
4,500,000
5,000,000
5,500,000

10-lb. stock is 15 per cent of the cracked gasoline made, and only 6.5 per cent of the thermal gasoline yield. Therefore in the case of catalytic cracking, alkylation, or at least polymerization may be more in demand to conserve these light ends.

Estimates show that the smallest practicable catalytic cracking charge capacity is of the order of 2,000-3,000 bbl. of fresh charge per stream day. Estimates of costs, etc., for one type of unit at present elevated cost figures are, approximately:

	2,000 bbl.	20,000 bbl.
Investment cost, 2,000 bbl./day charge	$900,000	$3,750,000
Invest. cost/bbl. fresh charge per day	450	190
Operating costs, direct, per bbl. charge, (excluding amortization)	0.30	0.13
Aver. gaso. yield, once through, vol. %	.....	45-53
Aver. gaso. yield, 0.5-1.0 recycle ratio	.....	54-60
Additional gasoline from polymerization, per cent	.....	4-5
Octane No. A.S.T.M. motor gasoline, 10-lb R.v.p., clear	.....	79-82
Octane No. A.S.T.M. motor gasoline, 10-lb. R.v.p., 3 cc. TEL	.....	87-90

From these generalized percentages and yields, production of 750,000 bbl. of catalytically cracked gasoline means a probable charge of 1,650,000 bbl. of gas oil; the amount of C_4s, butanes and butylenes will be of the order of 112,000 bbl. At normal estimate this should yield about 85,000 bbl. of alkylate, of 90-octane number or higher, assuming that an approximate balance between isobutane and butylenes exists in the light ends.

Estimates have been made that the probable postwar aviation-fuel demand of 45,000 to 50,000 bbl. daily may be half commercial and half military. Such a schedule would require, say, up to 35,000 bbl. per day of alkylate to make the entire 50,000 bbl. of military fuel into the super, above-100-octane-number fuel, which would call for about 50,000 bbl. per day of butane-butylene mixture. At the lower total rate, alkylate requirements would be reduced. A superfuel consists essentially of isopentane or its octane and volatility equivalent, and of alkylate, with little if any base stock or other blending agent, except tetraethyl lead. Butanes from natural gas or natural-gasoline sources must also be considered as possible competitors with refinery gases. All indications are that an immediate postwar demand for C_4s may amount to 25,000 to 50,000 bbl. daily for aviation alkylate, plus an indeterminate quantity for alkylation or polymerization for inclusion in motor fuels.

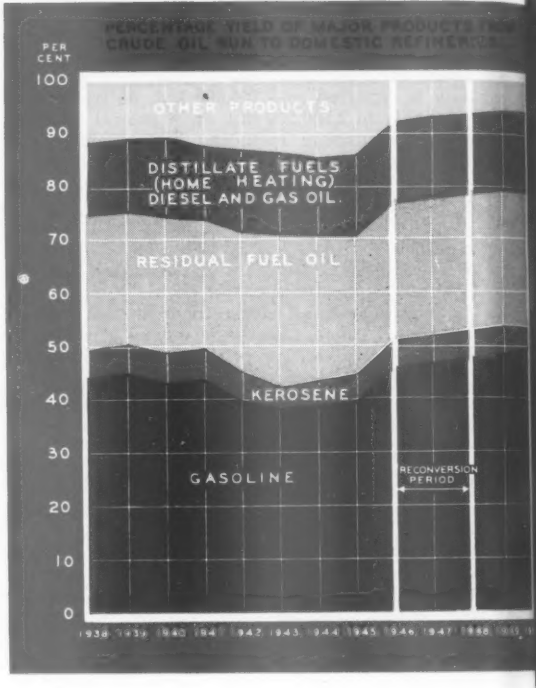
Disposition of Excess Butanes

In the prewar period the range of vapor pressures was from about 7-8 lb. R.v.p. in summer to 12-13 lb. in winter. Increase of pressure of only 2 lb. will dispose of 70,000 bbl. daily more butanes which, from estimated total butane-butenes production from catalytic cracking would absorb the available C_4s over and above the probable consumption for alkylate production. R. C. Alden has pointed out that alkylation is an operation essentially for reducing vapor pressure, the octane rating of raw material and product being about the same, but vapor pressure being reduced from around 60 lb. to about 2 lb. Reid. Utilization of the C_4s in this manner waits, of course, on the economics of processing to make the low vapor pressure products. In most cases change of 10 per cent to 25 per cent in the over-all cost of these products from crude, or in the price of crude itself, will make the cost-price differential needed to change the position of these processes from a loss to a profit.

Synthetic Rubber Intermediates

Authorities, official and industrial, appear to be certain that the synthetic rubber industry will continue to operate at capacity at least for a considerable postwar period.

If the butadiene required in synthetic rubber plants is derived from petroleum and natural-gas hydrocarbons it will consume some 30,000 bbl. per day of butanes and butylenes, it is estimated. Indications are that economics will force the manufacture of this butadiene from butanes and butylenes rather than from alcohol. Alcohol now costs the butadiene makers about 90 cents per gallon. Yield of 2.25 lb. of butadiene per gallon of alcohol makes the cost about 40 cents per pound, in contrast to 6.4 cents per pound of butadiene from butylene dehydrogenation. Even if alcohol is used in postwar operation of synthetic rubber, petroleum gases are proven by long experience to be the lowest cost raw material from which to produce industrial alcohol.



Chemical Synthesis to Expand

The production of synthetic chemicals and industrial and commercial products from hydrocarbons is on steady, in some cases rapid, increase. Styrene is used in synthetic rubber and in numerous resins and polymer material. Ethylene gas, derivable from the cracked gases from thermal or

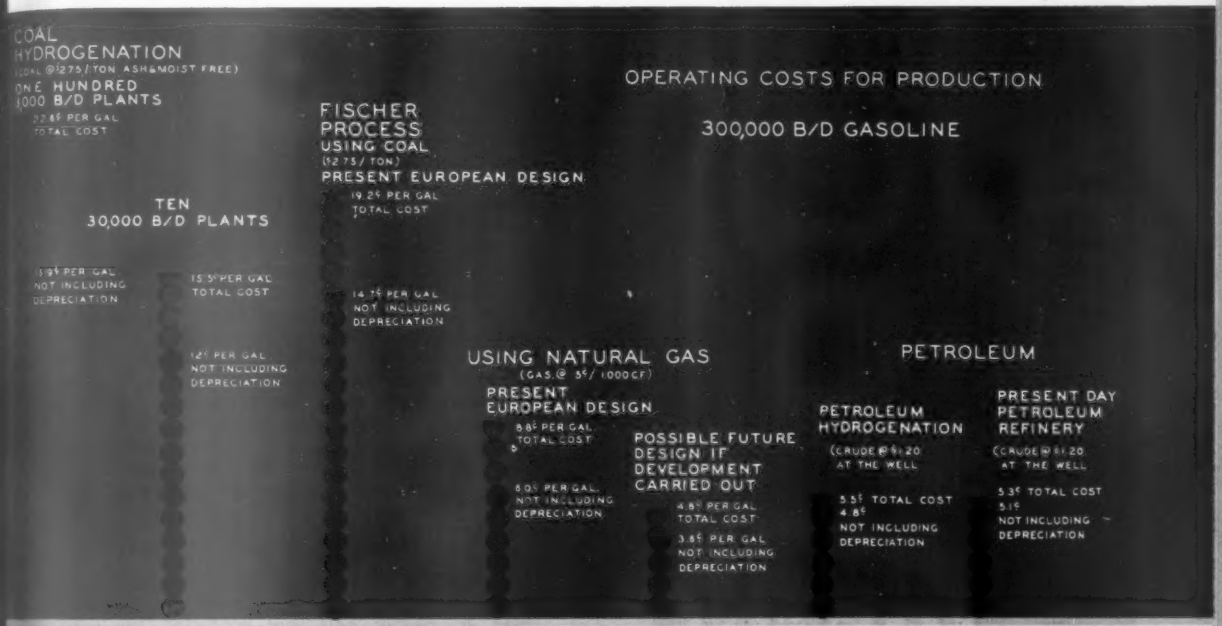
catalytic cracking, is used in styrene synthesis in relatively large quantities, yet the total poundage used annually would affect, in very limited extent, the total available ethylene. Huge quantities of alcohols, aldehydes, ketones, acids such as formic and acetic, and similar products are made at East Chicago, in West Virginia, Texas, Louisiana and elsewhere. One thousand barrels of butylenes per day will produce in the order of 10 million gallons of chemical products annually.

In the field of plastics and resins the ultimate possibilities are bright for consumption of large volumes of waste hydrocarbons. Production of large tonnage of industrial and commercial plastic materials is likely to increase more rapidly than some other lines, postwar, and the total amounts of hydrocarbons which may be used can become a significant part of the available surplus. Polymerization of ethylene makes special products such as lubricating oils, medium and high molecular weight resins, as intermediate for the production of other materials such as waxlike polymers, yellow-to-brown solid resins, and various complex polyolefins or paraffins or naphthenes. Acetylenes may be polymerized to viscous liquids; divinylacetylene may be polymerized to make synthetic drying oils. The chemistry of all these synthetics and their possibilities is highly involved; their consumption of raw materials in the postwar years in most cases will have little effect on the petroleum industry's supply of raw materials.

In 1942 the chemical manufacturing industry consumed 53 million gallons of liquefied petroleum gas delivered in liquid form in tank truck and tank car, but the amounts received by pipe line are not disclosed but are understood to be a large quantity.

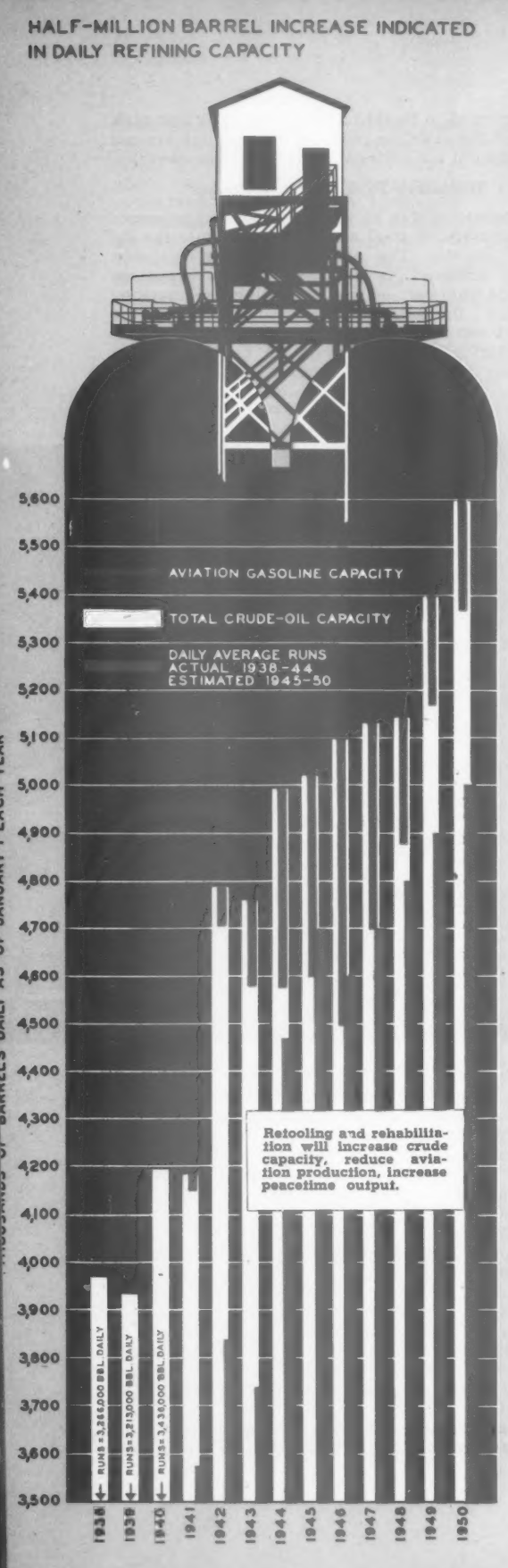
Necessary Process Developments

Improvements in all the major refining processes are necessary, if good economics is to rule the industry postwar. The catalytic cracking processes can be improved (1) by increasing the percentage of crude charged; (2) by increasing the cracking efficiency, the active life span and reducing the catalyst cost; (3) by reducing materially the installation (investment) cost; and (4) by cutting substantially the operating costs.


OPERATING COSTS FOR PRODUCTION
300,000 B/D GASOLINE
COAL HYDROGENATION
(COAL @ $2.75/TON ASH & MOIST FREE)
ONE HUNDRED 3000 B/D PLANTS
22.6¢ PER GAL TOTAL COST
TEN 30,000 B/D PLANTS
13.9¢ PER GAL NOT INCLUDING DEPRECIATION
15.5¢ PER GAL TOTAL COST
12¢ PER GAL NOT INCLUDING DEPRECIATION
FISCHER PROCESS USING COAL ($2.75/TON)
PRESENT EUROPEAN DESIGN
19.2¢ PER GAL TOTAL COST
14.7¢ PER GAL NOT INCLUDING DEPRECIATION
USING NATURAL GAS
(GAS @ 35¢/1000 CF)
PRESENT EUROPEAN DESIGN
8.8¢ PER GAL TOTAL COST
8.0¢ PER GAL NOT INCLUDING DEPRECIATION
POSSIBLE FUTURE DESIGN IF DEVELOPMENT CARRIED OUT
4.8¢ PER GAL TOTAL COST
3.8¢ PER GAL NOT INCLUDING DEPRECIATION
PETROLEUM
PETROLEUM HYDROGENATION
(CRUDE @ $1.20 AT THE WELL
5.5¢ TOTAL COST
4.8¢ NOT INCLUDING DEPRECIATION
PRESENT DAY PETROLEUM REFINERY
(CRUDE @ $1.20 AT THE WELL
5.3¢ TOTAL COST
5.1¢ NOT INCLUDING DEPRECIATION

Two methods for increasing charge stock available for cracking are vacuum distillation and deasphalting by solvents. Distilling the volatilizable portions of reduced crude from the heavy asphaltic residue under high vacuum inevitably will permit the cracking of larger percentages of crude, and may reduce the heavy residue to 5-10 per cent of the total crude.

Propane deasphalting-desalting methods are being tested now in large-scale operations to increase the total nonresidual charge stocks to catalytic-cracking units. According to available information, propane deasphalting eliminates 3 to 6 per cent of the original crude as extremely heavy material. Therefore, from an assumed 35 per cent of the original crude, some 30 per cent is recoverable as catalytic charge stock. At an assumed yield of 40 per cent cracked gasoline, catalytically cracking this fraction boosts the total gasoline by 12 per



cent. At the same time, from stocks obtained by either vacuum distillation or by deasphaltizing, the yields of commercial distillate furnace and gas oils is increased by several per cent, reducing the heavy residual No. 6 type of fuel oil correspondingly.

The case for alkylation is less clear. Much depends on operating costs of the process, yields of high-quality product and the demand. As a blending agent for obtaining octane numbers alkylate is now far more expensive than TEL. Isobutane and butenes are alkylated almost exclusively at present, with a very few exceptions.

The immediate future holds two main routes for alkylation: (1) continuance in the same fashion as at present, reacting isobutane-butenes mixtures; and (2) further research to improve greatly the reactivity of ethylene, propylene, amylenes, etc., to prepare on commercial scale more of the numerous isoparaffins of extremely high octane number —up to an estimated 130. Diisopropyl is essentially the combination of propane with propylene, each in the secondary position. Triptane, the "wonder fuel" component, is made theoretically at least by combining isobutane in the tertiary position, as isobutane always reacts, with propylene in the secondary position (carbon).

The one major application of isomerization as now known is the rearrangement of the molecular structure of mixed paraffins and olefins to increase considerably the octane rating of the product without appreciable treating losses. With at least five units operating or building with 17,000 bbl. daily capacity for isomerizing butanes, pentanes or mixed paraffinic light ends, the process is passing from the purely experimental stage for upgrading low-quality naphthas. As an aid to the average refiner this application may be far more important than is the isomerization of normal butane for making aviation alkylate.

Lubricants to Enter New Era

Project figures from PAW quote nearly 43 million dollars to be spent on lubricant plants, postwar, or nearly half that projected for catalytic cracking. This program will take three avenues:

1. Installation of solvent extracting and dewaxing units, to process lower quality crudes.
2. Synthetic processes for building large molecules from small or for molecular rearrangement.
3. Addition of specially chosen chemical products which accentuate desirable properties and bolster weaknesses of the natural hydrocarbons.

Synthetic Processes

Several processes are being studied to produce hydrocarbons from other raw materials. The U. S. Bureau of Mines is selecting site for an experimental but relatively large-scale oil shale plant in Colorado. The same agency has a coal hydrogenation unit in operation in Pittsburgh, and has already obtained considerable data. The most promising process possibly after oil shale is the Fischer-Tropsch method for making hydrocarbons and many other products from carbon monoxide and hydrogen. The Government has authorized spending some $30,000,000 on projects for synthetic-fuel development.

Controlling factors in these processes are costs. Large strides probably have been made in Ger-

many with Fischer-Tropsch, and cessation of war may disclose much of these advances. The best United States data are those presented by Russell before a Senate committee in 1943 and shown in the accompanying cost chart. Gasoline from coal hydrogenation costs three times as much to make (16 cents) as motor fuel from petroleum; by Fischer-Tropsch from coal, four times as much; from natural gas, about 60 per cent more than the 5.3 cents per gallon quoted for petroleum gasoline. On the basis of future expectable developments in the latter process, Russell indicates that gasoline from waste natural or refinery gases may be made competitive with the present petroleum product.

Trends in Fuel Quality

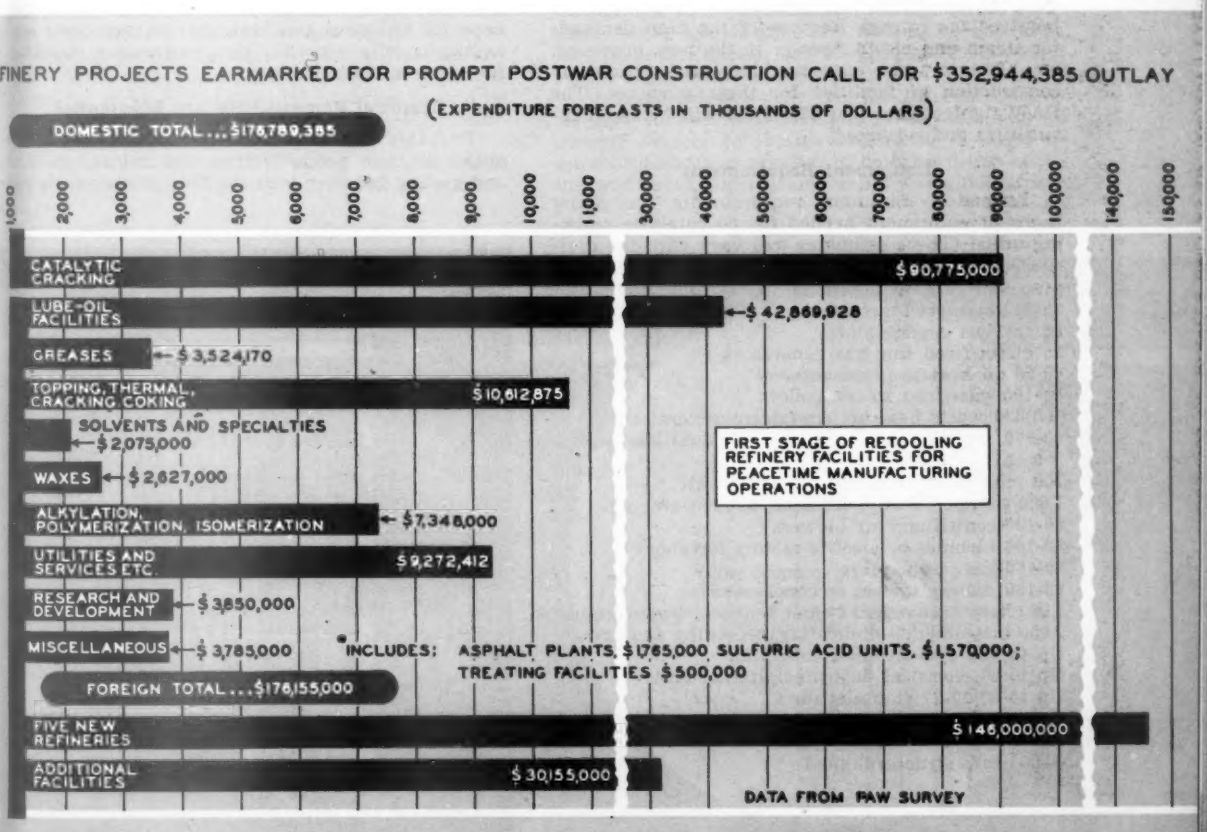
The conventional spark-ignition engine used for automotive and aviation power has two major principles to improve its efficiency and its maximum output — supercharging and solid injection. These are in addition to production and use of ultra-high octane number fuels which for aviation at least is already an accomplished fact. Continuance of the climb of antidetonation quality hinges on the synthesis or other methods of producing complicated molecular-structured isohydrocarbons.

Solid injection is an old story for diesel fuels, but undeveloped in this country for gasoline engines. The Germans appear to have solved it in their aviation-fuel systems. It offers serious obstacles especially in design of the injector which must operate on a fuel with the lowest possible viscosity. It offers advantages in controlling fuel-air ratios more exactly, engineers say. Supercharging offers no serious unsolved problems, it is believed, being a relatively old and well-tried practice.

Diesel-electric locomotives for fast railroad service will increase greatly, giving a market for larger amounts of medium-to-high quality diesel fuels. If these fuel demands can be satisfied with catalytic recycle oils, catalytic cracking will supply the fuel for this growing power. The automotive diesel picture is less clear, and waits on improvements in starting, repair facilities, and widespread distribution of fuel in retail outlets. Use of ignition improvers, such as organic sulfides, nitrites and nitrates, and similar materials to improve ignition qualities of diesel fuels will increase over an extended period. These additives leave something to be desired in fuel burning qualities but will aid in making medium-grade recycle oils usable as diesel fuels at lower prices than good straightrun products.

Gas Turbines—Jet Propulsion

On the lap of the future is jet propulsion of aircraft and land vehicles as well. The gas turbine is being studied intensively, rapid strides are being made. Jet-propelled planes are being flown experimentally; General Electric Co. has contracted to supply gas turbines for planes for the U. S. military forces. General use of these power plants prob-



ably will obviate the need for high antiknock fuels, since it is claimed that kerosene or low octane-number gasoline burns even better in such equipment than do the superfuels. Practical efficiency of the gas turbine has been improved in recent experimental units, 18 to 25 per cent thermal efficiency having been mentioned. A Swiss gas-turbine-driven locomotive shows 11.4 per cent thermal efficiency, 50 per cent higher than a steam unit.

Material Demands Postwar

The odor of clairvoyance in projecting future requirements for refining and natural-gasoline-plant construction and revamping is in good measure eliminated by the figures published recently by PAW, values obtained by asking refiners "how much of what" they expect to need in the immediate postwar era. Significant is the single item of $90,000,000 worth of catalytic-cracking plants. If the estimate of 80 to 100 new plants is within reason this will allow about a million dollars per plant. These cost figures refer to not more than half that number of cracking plants, though numerical data are not divulged. Thermal cracking is promised only a portion of $10,000,000, shared with topping units.

Surprising is the amount projected for alkylation, isomerization and polymerization — nearly $7,500,000. While not broken down into subdivisions, it seems likely that a considerable capacity in each process type is indicated. Large polymerization capacity was in prewar operation. It is possible that considerable naphtha isomerization is planned to boost octane ratings. Because of the high demands for steam and electric power in the new processes, manufacturers are expecting increased activity in construction of facilities for these purposes. The PAW figures state that $9,000,000 will be spent for "utilities and services."

Equipment Requirements

Estimated minimum requirements for major items of equipment needed for 80 catalytic cracking units: (These estimates will vary with the division of the total number of units among the various processes now available to the refining industry.)

80-240 catalyst reactors
80 catalyst regenerators
80 direct-fired flue gas generators
40-80 oil heaters (furnaces)
80-160 gas-fired steam boilers
160-320 waste heat boilers (steam generators)
80-160 fractionating columns with auxiliary equipment
700 pumps—charge, reflux, recycle, etc.
1,000 pumps—utility, transfer, condensate, etc.
80-100 centrifugal air blowers
80-100 turbines or electric motors for above
80-160 gas compressors
80-160 cooling towers or condensers
1,000 heat exchangers (vapor liquid or liquid-liquid)
2,000 instruments—indicating, recording and control
Up to 160 cyclone dust collectors
Up to 80 electrical dust precipitation units
Up to 80 12-17 stop elevators
Up to 3,000 to 4,000 expansion joints, 10-in. to 60-in. sizes
64,000 tons structural steel
40,000 tons steel plate (mostly fabricated as miscellaneous pressure vessels)
1,000 special, hydraulic operated slide valves
280,000 valves—globe, gate and plug

NATURAL GASOLINE operations in the postwar future will vary only gradually from that of the past, authorities assert. The main function always has been to supply volatility with medium-to-high antiknock values to gasolines. Its survival has been due to ability to supply this volatility at a lower price than obtainable from any other source. Its main function will continue to be that same job.

The natural-gasoline manufacturer has several lanes through which he may dispose of his product.

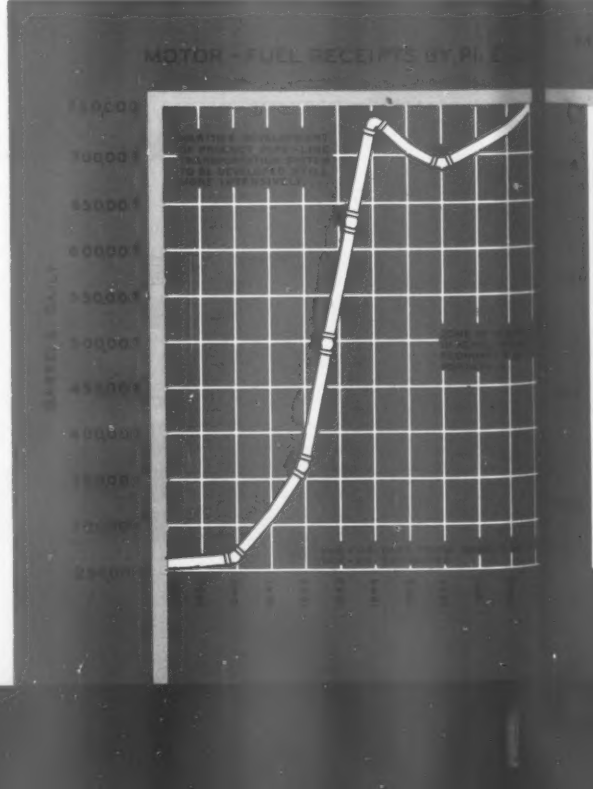
1. He can and will furnish volatility and octane numbers to the refiner at a price to induce sale of his product. Catalytic cracking may or may not make up to 60,000 bbl. per day of excess butanes, as has been predicted. Boosting vapor pressures 1 lb. Reid would care for more than half of that; demand for butadiene will use up 30,000 bbl. per day or more of butanes-butenes from the refinery, replaceable from natural gasoline in equal amounts.

2. When demand for natural does not use up the total, it can be cut to vapor pressure and blended with refinery naphtha, sold as motor fuel. This has been done before, successfully.

3. Special products can be made in many specific cases, such as isoparaffins, close-cut fractions for commercial and industrial products. Hydrocarbons for chemical synthesis can be produced economically only when the natural-gasoline manufacturer has a market outlet.

Chemical Potentialities Are Substantial

Probably the most attractive potential postwar outlet for new products from the natural-gasoline and cycling industry is in the field of chemicals and



plastics. Additional fractionating towers are being installed at several plants for recovery of ethane-propane mixtures to supply some of the major chemical manufacturers making acetaldehyde, alcohol, glycols, hexamine, carbon tetrachloride, perchlorethylene, chloroform, butadiene and a long list of others.

Inquiries have been reported by the Petroleum Administration for War in recent weeks from numerous large chemical manufacturers who are seeking large concentrated postwar supplies of ethane-propane mixtures which the natural-gasoline and cycling industry is in position to furnish with new plant installations or alterations of existing facilities.

Many refiners are convinced that much added volatility will be needed postwar. One item of interest: unlike thermally cracked gasoline, the higher boiling catalytically cracked fuel is relatively high in octane number, low in volatility. This should permit use of more heavy cracked material, with a corresponding increase in the light material used to balance the distillation range. This will lead to use of more natural gasoline and the recovery of light ends. This item may be of appreciable size, depending on the over-all octane rating and composition of postwar gasoline.

PIPE LINE engineering procedures will be influenced and changed by the future scope of mileage operated. Consequently, consideration should be given to imminent possibilities for expansion which will accelerate the development and application of modern techniques. In addition to large normal gathering and lateral line activity of crude-oil systems, long trunk lines may be expected to serve remote producing areas yet to be developed in the United States and foreign countries.

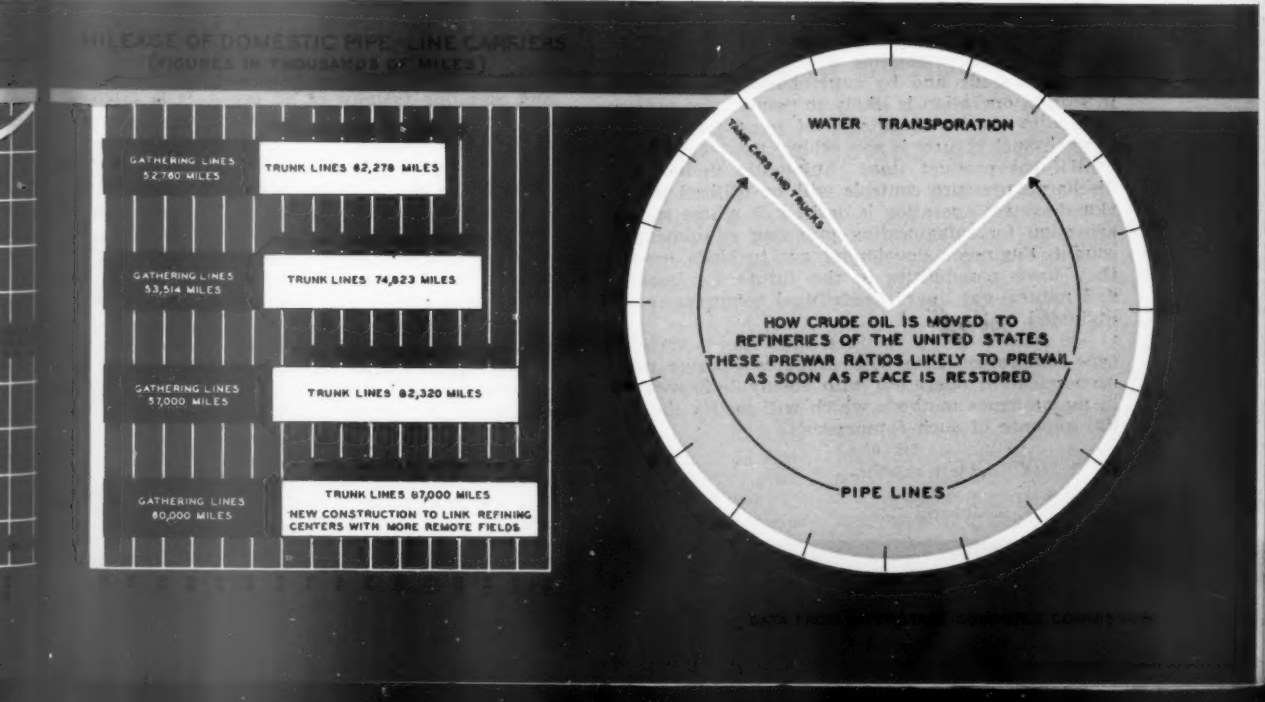
For product lines as well as for crude-oil lines, larger volumes may be anticipated with an increasing demand for diversification of batching. Product lines will be steadily expanded with smaller diameter laterals extending from trunk lines to handle more numerous small batches of products not now customarily consigned to pipe-line transportation.

Unless hindered by conflicting interests, natural-gas pipe lines have prospects for large expansion soon, not only for transmitting to great industrial areas now dependent on sources rapidly approaching exhaustion but also for serving immense potential markets in the North which have never been reached. Larger scale operations will stimulate technical progress which may exploit discoveries in the fields of metallurgy, plastics, electronics and automatic control.

Advances in pipe-line construction benefit crude oil, products and natural-gas systems. Recent utilization of larger diameter, thin-wall pipe of high-tensile steel for crude-oil and product lines promises to bring their construction problems closer, in many respects, to those of gas lines. Expensive delays in the handling of such pipe will be eliminated by cold-bending machines and internal line-up clamps. Hot bending is now considered obsolete. More pipe will be laid by stovepiping. Methods for speeding up ditching operations will get more attention.

Of much significance in future line construction is the rapid rise of pressure welding. The method has demonstrated its economies, is applicable to pipe of all types, is faster, eliminates distortion and stress and achieves uniformity of operation. More use of pressure welding is indicated. Ability to function in bad weather and over rough country has been demonstrated.

Telescopic design providing for different weights of pipe for various pressure conditions will be adopted widely by design engineers. A trend in some organizations appears to be toward less bending and more supervision of it by engineers, less


MILEAGE OF DOMESTIC PIPE-LINE CARRIERS
(FIGURES IN THOUSANDS OF MILES)
GATHERING LINES 52,760 MILES
TRUNK LINES 62,278 MILES
GATHERING LINES 53,514 MILES
TRUNK LINES 74,823 MILES
GATHERING LINES 57,000 MILES
TRUNK LINES 82,320 MILES
GATHERING LINES 80,000 MILES
TRUNK LINES 87,000 MILES
NEW CONSTRUCTION TO LINK REFINING CENTERS WITH MORE REMOTE FIELDS
WATER TRANSPORATION
TANK CARS AND TRUCKS
HOW CRUDE OIL IS MOVED TO REFINERIES OF THE UNITED STATES
THESE PREWAR RATIOS LIKELY TO PREVAIL AS SOON AS PEACE IS RESTORED
PIPE LINES

slack in the ditch, deeper burying of pipe at river crossings, more coating and wrapping and more cathodic protection. Experiments with improved pipe-cleaning machines, flame priming of pipe and with new protective materials are among developments striving for reduction in construction costs.

Economies in laying big pipe will contribute to the soundness of future planning of engineers for utilizing larger diameter lines. Sixteen-inch pipe will be used where 12-in. would have been customary for crude and product lines, and it is possible that 12-in. may be the minimum diameter for long petroleum lines. Much pipe of smaller diameter in multiple-trunk lines will be salvaged and replaced with larger diameter pipe.

Operating Economies Achieved

With larger diameter pipe, operation at higher pressure and wider spacing between pump stations, crude-oil and product systems will achieve important operating economies as well as valuable reserve factors which will be beneficial in winter weather, in pumping higher viscosity fluids, for handling peak loads, and in providing for future increase in capacity by installation of supplementary pumps at intermediate points.

Operating pressures above the usual 750 p.s.i. are predicted, probably up to 1,500 p.s.i. for petroleum lines up to and including 12-in.; 1,200 p.s.i. up to 16-in. and 1,000 p.s.i. for 20-in. lines designed for this purpose. Spacing of stations at 100-mile intervals would become common, with 200-mile intervals in exceptional cases.

In future specifications, provision will be made for reserve capacity in pumps and motors. Reserve capacity in diesel engines will be attained by increasing speeds and by supercharging. Simplicity in station operation is likely to result from present efforts to obtain advantages of more push-button control. Such control is now widely used on electric-centrifugal product lines. Automatic suction and discharge pressure controls will be utilized where closed-system operation is desired or where special provision for safeguarding pumping equipment is sought. Engineers developing gas turbines predict they have possibilities in the future for product and natural-gas lines. Centrifugal compressors are discussed.

On natural-gas pipe lines, high-speed, vertical-type-compressor units will probably become more economical in operation with steady improvement in maintenance methods which will justify the initial expense of such compressors.

Totally enclosed jacket-water cooling systems at compressor stations will be operated with provision for treating the water when it enters the system and periodically throughout the time it is used in order to eliminate corrosion and scale deposits which reduce efficiency and are expensive to remove. Planning for new gas lines will be influenced by utilization of underground storage and the possibilities of methane liquefaction. Dehydration of gas, injection of inhibitor in product lines, care in the removal of water from gasoline and appropriate scraper schedules will continue to receive close attention.

Design of future station buildings will profit from more economical construction methods recently developed. There will be a trend toward designing manifolds for higher pressures. After the war, cast-steel valves will be used except for low pressures. Displacement meters will be used more on crude-oil and product lines where they have demonstrated their practical value in recent years.

Advancements in Communication

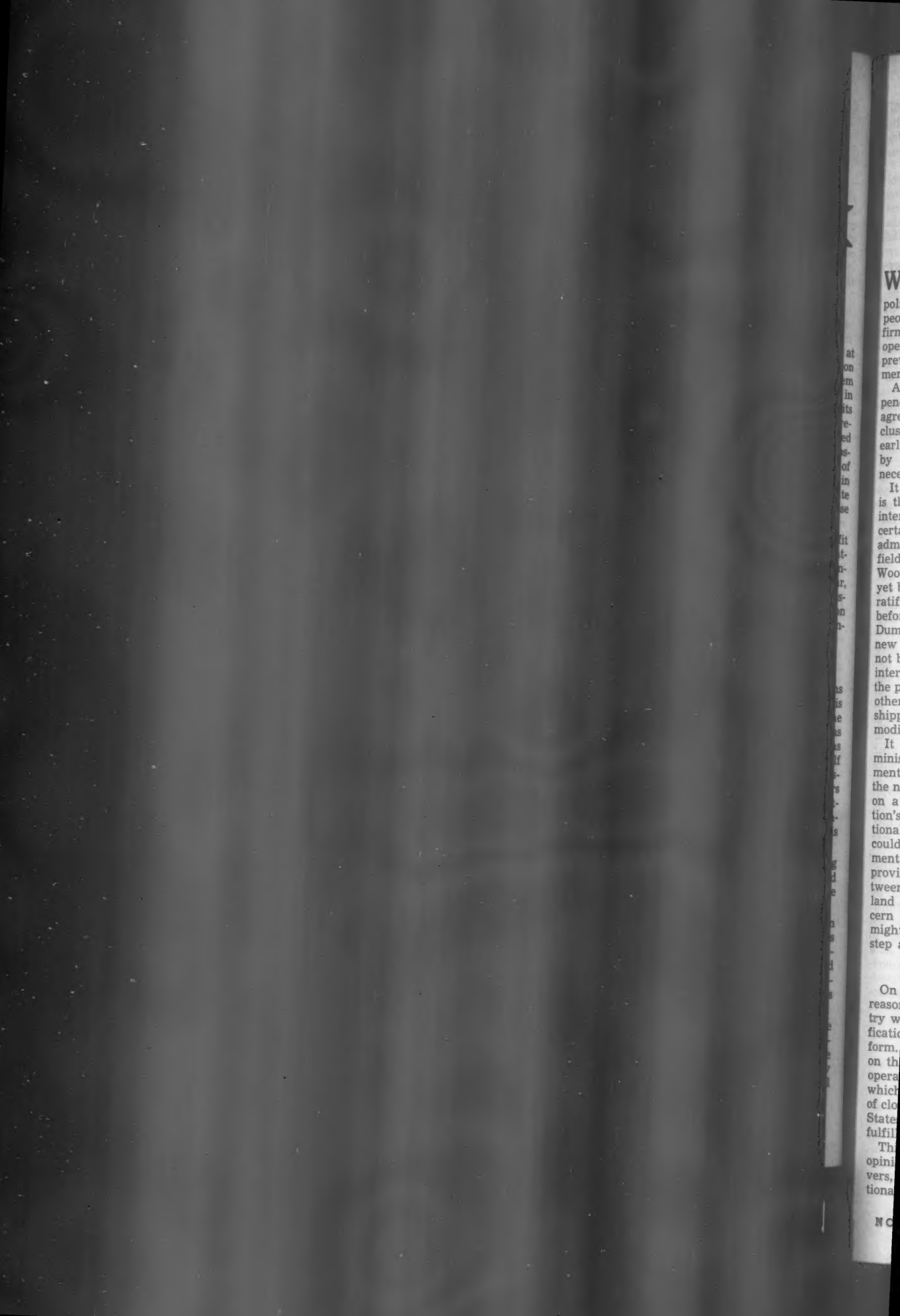
Although radio communication between stations and with line walkers carrying "walky-talkies" is now practicable from an equipment standpoint, the matter of obtaining assignment of wave lengths from the Government remains a difficulty. Means for communicating by utilizing the pipe line itself have not been devised for operation over the distances required but some communication engineers assert that research for the purpose should be attempted. It is claimed that need for complete insulation of the line has been exaggerated in this connection.

Airplanes will be used more widely for patroling long pipe-line systems of all types. It is predicted that helicopters will be employed in maintenance of lines and stations.

For identifying the location of severe corrosion which might not be discovered by present methods there is the possibility of utilizing recently developed electronic techniques which may be applied in connection with the passage of a batch of radioactive fluid through the line. Electronic principles may be employed in the timing of diesel engines.

New developments will reduce costs of crude and refined petroleum transportation and gas transmission. Expansion of all branches of the pipe-line industry may be confidently predicted to follow engineering advances unless impeded by political obstacles.

CONCLUSION



Election Results Make Oil Pact An Exceedingly Vital Issue

by Henry D. Ralph

WASHINGTON. — The national election, in the opinion of most political observers, means that the people of the United States are firmly committed to international cooperation to preserve the peace and prevent friction between governments.

Applying this interpretation to the pending Anglo-American petroleum agreement might lead to the conclusion that the way is paved for early ratification of this agreement by the Senate, but this does not necessarily follow.

It is true that the oil agreement is the first of a projected series of international agreements and to a certain extent may be a test of the administration's new mandate in the field of foreign policy. The Bretton Woods monetary agreement has not yet been submitted to the Senate for ratification, though it was drafted before the oil agreement, and the Dumbarton Oaks framework for a new United Nations organization has not been put into complete form. An international rubber agreement is in the preliminary discussion stage, and others are proposed to govern world shipping and trade in various commodities.

It might be possible for the administration to push the oil agreement through the Senate soon after the newly elected Congress convenes on a plea to demonstrate this nation's willingness to begin international collaboration. Such a plea could point out that the oil agreement on its face is very simple and provides only for consultation between the United States and England on petroleum problems of concern to both. Thus the agreement might be described as only a short step away from isolationism.

Basis of Opposition

On the other hand, there is no reason to believe that the oil industry will be any less opposed to ratification of the treaty in its present form. This opposition is based, not on the principle of international cooperation, but on the means by which this may be carried out—fear of close federal control of the United States oil industry in the guise of fulfilling international obligations.

This same stumbling block, in the opinion of many Washington observers, will be implicit in all international programs coming before Congress. The view is widely held that Congress will approve political collaboration but will be extremely skeptical of economic collaboration, particularly of anything that looks like a cartel or restrictions on the freedom of American business. Where an international proposal, like the oil agreement, carries with it serious implications for a domestic industry, Congress most certainly will give it the closest scrutiny, and may be expected to give great weight to the views of the industry affected.

Economic Isolationism Not Dead

Political isolationism may be dead, but economic isolationism is not. There will undoubtedly be a postwar attempt toward lowering of tariffs and trade barriers throughout the world as a means of developing international trade and good will, but this is bound to encounter opposition from special interests, and special interests always have carried great weight in tariff discussions. The reciprocal trade agreements program probably will be continued and possibly liberalized in scope, but nothing in the election returns suggests that Congress is ready to scrap the entire protective tariff system.

If the question of duties on imported crude and petroleum products arises in the course of postwar economic and tariff adjustments it is likely that Congress will react as it has in the past and will not approve any free-trade plan which threatens to injure a domestic industry in assisting a foreign enterprise.

Little Change Expected

On the domestic issues, the election should bring little change affecting the petroleum industry. Harold L. Ickes went through his traditional ceremony of submitting his resignation as secretary of the interior in order to permit the president to reorganize his cabinet if he so desires, but nobody, particularly Ickes, expects this resignation to be accepted. The Petroleum Administration for War, Office of Price Administration, War Production Board, and other war agencies of the Government that concern the oil industry, will continue as in the past, and the only changes to be expected are those growing out of shifting war conditions.

The new Congress, of course, will be more responsive to the desires of the White House, but a great many members of both House and Senate were elected by such slim majorities that they will be bound to give ear to the wishes of the minority of their constituents, particularly on domestic issues. The coalition of conservative southern Democrats and Republicans, which held the balance of power in the last Congress, has not been liquidated and still must be reckoned with.

Both Democratic and Republican platforms and candidates praised private industry and promised support of the free enterprise system, and the prospects are that the new Congress will be just as hostile to bureaucratic control of business as the present one has been during the past year.

Pipe Lines Could Compete With Tankers, Jesse Jones Suggests

WASHINGTON.—Actual operating costs of the Big Inch and Little Inch pipe lines, released by Secretary of Commerce Jesse H. Jones, reveal that crude oil and products can be moved through them between Texas and New York for less than the charges for transportation by tanker.

The cost of shipping crude through the 24-in. line, including gathering charges and amortization, is 38 cents per barrel, compared with the tanker rate of 60 cents. The products cost through the 20-in. line is just under 25 cents per barrel, compared with the tanker rate of 40 cents. The figures are for operation of the lines at approximately maximum capacity, as they are at present.

"These pipe lines," said Secretary Jones, "should be able to operate after the war in competition with ocean tankers and other transportation facilities for moving petroleum and petroleum products from the Southwest to the eastern seaboard, and it should be possible to sell the lines to private industry with reasonable allowance for depreciation."

The following statistical information regarding the cost and operation of the two War Emergency Pipelines was furnished by Jones:

24-IN. LINE (BIG INCH)

Capital Cost

Pipe line, right-of-way, and necessary buildings	$77,112,000

Operating Cost per Barrel of Oil Transported

Gathering and transporting oil to Longview, Tex., approx.	$0.23
Transporting oil through line, Longview to New York, approx.	0.08
Depreciation and amortization of investment in 20 years, including interest on working capital, approx.	0.07
Total	$0.38

These figures may be compared with other methods of transportation, based on War Shipping Administration rates for tanker movements and current rail tariffs for rail movements, as follows:

	Tank cars	Tankers
Gathering costs	$0.075	$0.176
Transportation	1.522	0.430
Total	$1.597	$0.606

Editor's note.—The combination gathering and tanker rate of 60.6 cents used in the above table is substantially in excess of the prewar rates. In 1941 and earlier crude oil was shipped by pipe line to the Gulf Coast and by tanker to East Coast points at combination rates totaling 30 to 40 cents per barrel. Combination rates in the shipment of crude oil from other Texas points were comparable.

20-IN. LINE (LITTLE BIG INCH)

Capital Cost

Pipe line, right-of-way, and necessary buildings	$65,654,000

Operating Cost per Barrel of Oil Transported

Delivering products to line	$0.004
Transporting products through line, Gulf Coast to New York	0.106
Depreciation and amortization of investment in 20 years, including interest on working capital, approx.	0.133
Total	$0.243

Current tariffs for shipping products between the same points are $1.74 per barrel by rail tank car and 40 cents per barrel by tanker, without including any computation for gathering charges.

Operating statistics through September 30, 1944, are given as follows:

BIG INCH CRUDE LINE

	Barrels
Deliveries to Norris City and from there by rail prior to completion of the eastern leg of the line	44,951,946
Deliveries to eastern seaboard via oil pipe line	110,726,371
September 1944 Deliveries	
Total	9,620,869
Daily average	320,695

20-IN. PRODUCTS LINE

	Barrels
Deliveries to Norris City by pipe line and thence by rail prior to completion of eastern leg	183,189
Deliveries to eastern seaboard by pipe line	37,217,756
September 1944 Deliveries	
Total	6,228,256
Daily average	207,608

The value of the crude oil and petroleum products being transported in the two pipe lines on September 30 totaled $21,904,000, which is approximately the figure for the value of the oil in the lines at any one time when both are being operated at capacity.

The two lines are completely financed and owned by Defense Plant Corp. They are not operated as common carriers but wholly for the account of the Government. All oil transported is owned by the DSC, which purchases it in Texas and sells it to refiners and marketers at the eastern terminals.

Actual operation is done by War Emergency Pipelines, Inc., as operating agent for DSC. This is a nonprofit corporation organized by members of the oil industry to construct and operate the lines for the account of the Government. It is prohibited by contract from operating in any capacity whatsoever except as operating agent for the Reconstruction Finance Corp. subsidiaries.

In selling crude oil and products at the eastern end of the lines, DSC adds 80 cents per barrel to the posted field price of crude oil and 65 cents per barrel to the refinery price of products. However, since the transportation costs on substantially all the crude oil and products moving to East Coast destinations are equalized, the amount of the increment added to the purchase price of petroleum transported through the pipe lines is immaterial.

WEP currently has 1,119 operating employes, besides 29 executives and 62 office personnel in its Cincinnati office. Its total expenditure for wages and salaries from September 15 to October 15, 1944, was $325,724.54.

Nazi War Machine Creaking From Oil Lack

NEW YORK.—Germany's oil supply position is at a low ebb, says Shell News in its current issue, citing the loss of the Romanian oil fields, bombing of German refineries, and synthetic-oil plants. There is little doubt, it says, that the bombings caused the grounding of the Luftwaffe and enabled the invasions of Europe to be completed with practically no air opposition.

"During the early 1930's," it continues, "the output of German wells was less than 1½ million barrels a year. By 1939, the last year from which accurate reports are available, the output had increased to over 4 million barrels annually. Thirteen new areas were developed during the 7 years from 1932 to 1939.

"The most important production center in Germany was the Hannover area. The largest contribution toward new production was in an area near Hamburg, where new fields were discovered during 1937 and 1939. It is believed that the footage drilled during 1940 was about double that of the previous 2 years.

"Acquisition of Austria and Hungary added another several million barrels annually, while the conquest of Czechoslovakia only gave the Nazis an additional 125,000 bbl. The invasion of Poland brought Germany not only oil fields but several refineries. Germany's conquest of Poland was successful from a petroleum standpoint as well as from a military one; Hitler secured another 4,000,000 bbl. of oil every year. Geologists felt that the Poles had not used the fields to the fullest extent and that Germany would probably increase production.

"As in Romania, France, and other European countries, affiliates of the large oil companies operated wells and fields in Germany. Before the war Standard-Vacuum, as well as the Shell Group, had interests in that nation. The Group operated seven refineries which ranged upward from the small Freital refinery with a capacity of 200 bbl. a day, to the Harburg-Wilmsburg with a 5,000-bbl.-a-day capacity. The average daily refinery capacity was a little over 2,000 bbl. In Austria the Germans seized the Shell Group's Vienna Floridsdorf refinery which had a 3,800-bbl.-per-day capacity.

"But all of this was not nearly enough to satisfy the enormous demands of the Luftwaffe. Even the seizure of Ploesti made the total output of natural crude a drop in the Nazi's oil bucket. German statisticians estimated that a minimum of from 78 to 150 million barrels a year would be needed. These estimates were based on operations similar to those used in the first World War. When Hitler declared war on Russia even these estimates were antedated and a decided revision was in order.

"But Hitler's problem was difficult. . . . Even the most conservative estimate could not be satisfied by combined output of all the European production available to the Nazis. The only solution was to keep natural crude production at a constantly high point and to experiment with synthetics. This experimentation was evidently highly successful. The Luftwaffe was able to keep flying for considerably longer than many military experts had believed possible.

"The bombing of refineries, fields, and installations has been at a high peak for several years. Most of Germany's refineries have been at least partially destroyed; the operation of all of them handicapped seriously. When United Nation bombers completed their work on crude-oil refineries they began the task of destroying the synthetic plants."

THIS WEEK

INTERNATIONAL—Resignation of Iran's premier adds to concern over conditions brought about by that country's refusal to grant oil concessions to Russia. . . . Explosive potentialities seen in dispute involving one of world's richest petroleum deposits. . . . United States and Great Britain involved. . . . Iran may be proving ground of United Nations policies and of "Big Three" cooperation. . . . ¶Pacific Coast geologists told center of oil production shifting to Far and Middle East. . . . Time for producers to look across ocean and see what's going on. . . . ¶Gulf Coast refiners denounce Anglo-American pact as vague, unfair, threat to American business, dangerous grant of power to a commission. . . .

PRODUCTION—Texas contributing 93.6 per cent of nation's increase in crude output this year. . . . ¶Engineers plan series of tests to determine potentiality of basal Hunton lime zones in West Edmond field. . . . ¶Country's daily production up 12,500 bbl. to 4,731,850. . . . Compares with all-time peak of 4,758,200 bbl. recorded last September. . . . Principal increases in California, 4,900 bbl., and Kansas, 5,800. . . .

ECONOMICS—Cooperatives plan world-wide federation to handle oil products. . . . Predict world trade will be conducted increasingly by cartels. . . . See Anglo-American pact as forerunner of similar setups. . . . ¶Bradley Dewey says free enterprise and technical experts enabled nation to leap from standing start to leadership in technological warfare. . . . Rubber program exemplifies teamwork and skill "without which we might have become a captive people." . . . ¶Secretary Jones asserts war pipe lines could compete with tankers in peacetime. . . . Move oil between Texas and New York for less than wartime ocean transportation costs. . . .

TRANSPORTATION—Refiners protest against movement of railroads to reinstate 6 per cent increase in freight rates, currently suspended. . . . Unnecessary now. . . . Predicated on expectation of conditions which cannot be foretold. . . . ¶OPA simplifies regulation governing maximum rates for tank-truck transportation of oil products by contract motor carriers. . . . ¶Increasing purchases of planes by oil men indicate industry is turning to air as solution of many transportation problems. . . .

WAR—Nazi synthetic-oil plants receiving increased attention of Allied air raids. . . . More than 1,500 bombers in recent attack on big Leuna plant, formerly good for 50,000 metric tons of synthetic products monthly. . . . Output of Homberg plant, formerly producing 16,000 tons of oil monthly, reduced 75 per cent. . . . ¶Germany's war machine declared creaking for lack of gasoline, lubricants. . . .

Members of an engineer unit make final connections with ship-to-shore distribution system of petroleum on the west side of Cherbourg Harbor. The tanker, "Empire Traveler," was the first to discharge its cargo at a French port in this manner

Acme—Signal Corps Photo

Resignation of Premier Adds to Concern Over Iran Oil

WASHINGTON.—The reported resignation of Premier Mohammed Saed, whose Iranian government has been under attack from Russia because of refusal to grant the latter country oil concessions, has deepened concern over a disturbing situation. Both this country and Great Britain are affected.

Russia and Britain took over Iran in the summer of 1941, dividing the country into northern and southern spheres of influence. Iran long has been regarded as potentially one of the world's richest sources of petroleum.

Americans are spread out from the Persian Gulf in the south to the Caspian Sea in the north along the highways and railroads over which arms for Russia have been rolling. Americans are further involved by virtue of several missions which are advising the Iranian government.

Some classify Iran as the "proving ground" of United Nations policy as well as a major test of the ability of the "Big Three" to work together.

Iran, formerly known as Persia, has been Russia's "Burma Road" for American lend-lease supplies. It is the only country in which there are troops from each of the "Big Three." It is a country in which the interests of Russia and Britain—economic, political and strategic—collide.

"The United States and Great Britain are willing to compromise for a satisfactory settlement of the Polish question, but Britain will never compromise its position in Iran," said one official.

Officials here fully expected Premier Saed to resign, but they predict that his successor will follow the same policy of refusing to grant oil concessions to the Soviet Government.

American Officials Concerned

American officials are concerned by the fact that most of the news about the dispute has been coming from Moscow. The latest Russian criticizing the Iranians raised the question of American troops in Iran without benefit of a treaty. It was felt here that an oblique criticism of the United States Persian Gulf command was unbecoming in the Soviet Union as the American troops were sent to Iran to expedite transshipment of American lend-lease goods to Russia.

The crisis was precipitated by Russia's belated request late in September for Iranian oil concessions at about the time the Iranian government was prepared to grant a concession to one of two American oil companies or one British company in southeastern and central Iran. The British government-owned Anglo-Iranian company now holds the only oil concession in Iran.

Details of Russia's demand are not publicly known, but immediately thereafter Premier Saed rejected the Soviet Union's request and then was forced to cancel all negotiations with the British and Americans until after the war. Since then the Moscow press denounced the Iranian Government.

Gulf Coast Refiners Rap Anglo-American Pact

HOUSTON.—A resolution adopted by the Gulf Coast Refiners Association vigorously opposes ratification by the U. S. Senate of the Anglo-American oil agreement submitted by the president last August, condemning it as a threat to American business, a dangerous grant of power to a commission, vague and unfair. Reasons for the association's stand are set forth as follows:

1. It would set up an International Petroleum Commission which would exercise vast control over, and a degree of regulation of, internal affairs never granted to the Congress by the constitution in the field of legislation. And a precedent of granting more power to an international commission than can be exercised by the Congress itself is so dangerous as to constitute a threat to every phase of American business.

2. Any "advisory" body set up to function under conditions of a treaty would inherit, through its sponsorship by the American and British governments, sufficient power to enforce its decisions upon the domestic petroleum industry and would thus secure complete domination of petroleum production, transportation, refining and marketing in this country and on a world-wide basis, to the ultimate total elimination of free enterprise.

3. The proposal blandly and improperly assumes that other sovereign nations, owners of petroleum reserves and consumers of petroleum products, will submit to Anglo-American world-wide regulation of the petroleum industry. The interests of other nations are certain to be affected greatly by the proposed regulation.

4. Should one or more other nations join in the ratified agreement, the United States might find that, in matters of national safety and internal regulation, it was outvoted by more numerous foreign representatives. Thus this agreement would result in a delegation of sovereignty and authority, by the Senate, which was never contemplated when the constitution gave it the power to ratify treaties.

5. The wording of the agreement is so vague in many respects that, if ratified as a treaty, the United States may find itself committed, by interpretations of the language, in many respects not now foreseeable.

6. The agreement is unfair, in that it does not apply where "imperial preferences" of the British Empire would suffer; while the agreement would apply where interests of the United States would suffer.

McKeever Named Head Of Pan American P. & T. Co. and Its Subsidiaries

HOUSTON.—E. G. McKeever, executive vice president of Pan American Petroleum & Transport Co. since 1937, has been elected president of Pan American and its subsidiaries. He will assume the new office January 1, 1945, succeeding Dr. Robert E. Wilson, who recently was made chairman of the board and chief executive officer of Standard Oil Co. of Indiana, also chairman of the board of Pan American and certain of its subsidiaries. McKeever joined Pan American in 1915 and has held many positions of responsibility.

D. J. Smith will become president of Pan American Production Co., Pan American Pipe Line Co. and Pan American Gas Co., with producing and pipe-line properties in Texas and Louisiana; Pan American Refining Corp., operating refineries in Texas City, Tex., and Baltimore, and Mexican Petroleum Corp. of Georgia, which operates a refinery at Savannah. His headquarters will remain in New York City.

P. J. Sweeny, manager of the company's large refinery at Texas City, will become a vice president of Pan American Refining Corp.

E. R. Turner succeeds McKeever as first vice president of Pan American Production Co., Pan American Pipe Line Co., and Pan American Gas Co., with headquarters in Houston. Turner joined Pan American as general manager of the production and pipe-line companies in 1935, was made a vice president in 1939 and upon the formation of the gas company in 1941 was made vice president of that company.

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Postelection

OBSERVERS within and without the oil business are raising the question as to where the election leaves the oil business. The query could be answered briefly with the statement that the industry now knows definitely that it will have to be vigilant as never before to assure the continuance of those operating principles on which it was founded and around which it has established itself as a major enterprise equally essential in both war and peace.

Continued full-scale cooperation with the administration in bringing the war to a successful conclusion is, of course, assured. Every day, in all parts of the oil country and in scattered operations elsewhere, the war is brought to many homes with reports of casualties among the industry's fighting sons engaged on every front. No expansion of effort nor any sacrifice on the part of individual operators will be too great if it will shorten the war by one day. Those responsible for the conduct of the war know that and will act accordingly.

More attention must be paid to the furtherance of understanding relationships between the oil industry and its customers, which includes everybody. The war has greatly increased the public's knowledge of oil operations and its dependence on their products during an emergency. The industry will be dilatory in its obligations to itself and the nation if it fails to follow through and utilize this good will in establishing permanent cooperation which will make every industry problem a consumer's problem with solutions that will protect both.

There is an agreement among commentators that the election gives full support to an international plan looking to a prolonged peace. There were no substantial differences between the parties as to that program, and certainly none among oil operators.

The dominance of oil in a sound final treaty is apparent everywhere. Approval of the proposed Anglo-American oil agreement by the present Congress or by the one which takes office in January is now more probable than it was 10 days ago. If it fails of approval a substitute in some form will be offered later. In the light of new oil discoveries, an international oil plan is certain.

Managements have given everything they had to the solution of war-production problems. The results speak for themselves. Now there are additional and new-type responsibilities. A world economy long geared to war and war preparation has to be redesigned and brought back into peacetime channels. Who is more familiar with what needs to be done than petroleum operators, whose products are distributed everywhere?

Then there are the domestic operations. The realists know that any foreign policy, no matter how well conceived and how well effectuated in its early stages, will fall apart unless it is supported by sound business conditions in this country. What happens to oil in our domestic economy, which now supplies and consumes more than 65 per cent of the world's petroleum, will be a controlling factor in general business trends.

These are some of the conditions which indicate the postelection position of this industry. Equally obvious is the fact that these conditions mean that still greater stress must be placed on petroleum leadership of the future.

Center of Production Shifting From U.S., Geologists Told

by L. P. Stockman

LOS ANGELES.—The center of oil production is shifting from the United States to the Far and Middle East, and it is time for Americans to look across the ocean and see what is going on, declared Mortimer Kline, Los Angeles attorney, until recently on the staff of Petroleum Reserves Corp., in a talk which closed the annual meeting here last week of the Pacific Section American Association of Petroleum Geologists. Estimating water transportation charges at 40 to 60 cents a barrel, Kline expressed belief that crude and refined oils from those regions could be laid down in the United States for about $1.75 a barrel.

In the event of another war, asked Kline, how could this country acquire a volume of oil equal to that now demanded by war operations, including what is shipped to Allies under lend-lease agreements? Although new reserves will be found in the United States, it would be virtually impossible to meet the requirements of possible wars of the future. For this reason, said the speaker, oil resources of the Far and Middle East assume immense importance, especially as American companies have interests there.

Dr. Judson L. Anderson, of Johns Hopkins University, who spent 12 years as an oil geologist in West Africa and South America, discussed the importance of Colombia, with its population of 8,701,816. At least six petroliferous provinces can be recognized in Colombia. They are the Magdalena Valley; the southwestern basin area of Lake Maracaibo; the plains, or llanos area, in the southeastern part of the country; the coastal area of the Caribbean; the Goajira Peninsula, and the Pacific Coast region. The most important of these at present are the middle Magdalena Valley and the southwestern Lake Maracaibo area. Travel is difficult except in the uplands.

Cretaceous limestones and shales are extensively developed east of the Central Cordillera and are highly petroliferous. Cenozoic deposits are found in the intermontane valleys, in the llanos area and along the Caribbean coast. In the middle Magdalena Valley there are important reservoir beds of petroleum. Large overthrusts are characteristic features of the Magdalena Valley and they also occur in the llanos area in the valley west of the Cordillera Central and in the southwestern Lake Maracaibo basin area. In the Magdalena Valley and in the southwestern Lake Maracaibo area petroleum occurs on faulted anticlines. In the coastal region, sharp anticlines, with some faulting are known.

Source of Production

Oil and gas seepages and mud volcanoes are of common occurrence and little is known of the structure of the Goajira peninsula and the Pacific Coast areas. Production comes from Oligocene and Eocene sands in the middle Magdalena Valley. Two structures, Infantas and La Cira, produced all the oil of this region up to about 1943. Two new fields have been added. The Barco area, in the southwestern Lake Maracaibo basin, obtains its oil from the Cretaceous and Tertiary, on faulted anticlines. In the Cesar Valley, in the lower Magdalena Valley area, production of high-gravity crude oil from Oligocene limestone has been reported in new wells. Dr. Anderson is a member of the Distinguished Lecture Committee of A.A.P.G.

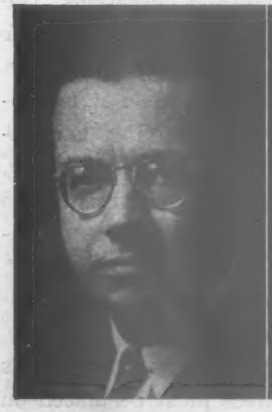
A. I. Gregersen, district geologist for Petroleum Administration for War in District 5, reviewed exploratory activities and oil and gas discoveries in California during the first 9 months of 1944 and predicted that the current year will provide an all-time high in the state's exploratory drilling. An abstract of this article is published in this issue, starting on the next page.

Other important papers presented included "Symposium on Inclined

R. G. REESE
President, Pacific Section, A.A.P.G.

G. C. KUFFEL
President, Pacific Section, S.E.P.M.

ROBERT ATWILL
Chairman of the program committee



E. W. GALLIHER
Chairman of session

E. B. NOBLE
Chairman of session

HAMPTON SMITH
Chairman of session

Water Tables," by Norris Johnson, General Petroleum Corp.; "Tar Sands of California," by Ben M. Page, U.S.G.S.; "Some Stratigraphic Relations in the Salinas Valley," by M. N. Bramlette and S. N. Davies, U.S.G.S.; "Stratigraphy of Puente and Jose Hills," by A. O. Woodford, J. S. Shelton and T. G. Moran, U.S.G.S.; "Tertiary and Late Upper Cretaceous Stratigraphy, West Border of San Joaquin Valley, North of Panoche Creek, California," by Ralph Stewart, W. P. Popenoe and P. D. Snavely, U.S.G.S.; "Some Features of Santa Susana Thrust, Vicinity of Aliso Canyon Field, Los Angeles County, California," by John C. Hazzard, Union Oil Co.

Glenn Bowes, of Continental Oil Co., was elected president, succeeding Richard G. Reese.

Presiding chairmen at the various sessions were E. Wayne Galliher, chief geologist of Barnsdall Oil Co.; Earl B. Noble, chief exploratory geologist in foreign fields, Union Oil Co.; Harold W. Hoots, chief geologist of Richfield Oil Corp., and Hampton Smith, chief geologist The Texas Co., California division. Richard G. Reese, president of Pacific section, presided at the luncheon for speakers, guests and members of the national association, and Martin Van Couvering, consulting petroleum engineer of Los Angeles, discussed "Inclined Water Tables at Kettleman Hills."

The Society of Economic Paleontologists and Mineralogists held an evening meeting November 9 and heard a paper on "Stratigraphy and Micropaleontology of West Side of Imperial Valley, California," by W. H. Holman and L. A. Tarbet, of Standard Oil Co. of California. Stanley Siegfus, of Pacific Western Oil Co., was elected president, succeeding George C. Kuffel. Jack Ruth, of Standard Oil Co. of California, was elected secretary.

Exploratory Activity and Oil, Gas Discoveries in California, 1944

by Albert I. Gregersen*

California is still drawing on oil reserves at a rate five times as fast as new reserves are being discovered although new discoveries of oil seem impressive in number. Discoveries of gas reserves are the reverse of the oil picture, four wildcat strikes and a deeper pay in the Rio Vista field give promise of being major gas strikes. This is a digest of a paper presented before the Pacific Section, A.A.P.G., November 10, 1944, at Los Angeles.

THE number of wildcat discoveries of oil and gas fields in California during the first 9 months of 1944 is impressive, but the amount of oil discovered is not. The gas discoveries appear to have greater potentialities and two or three may turn out to be of major importance.

In classifying discoveries and exploratory results, the classification of Dr. F. H. Lahee has been used as a guide, with some modifications in order to make the data comparable with 1943 reports.

There have been 24 wildcat discoveries of oil and 31 successful new pool tests and outposts during the first 9 months of 1944. Six wildcat gas discoveries have been made and a deeper pay found in the Rio Vista gas field. The following are the discoveries:

Wildcat Discoveries

Jacalitos Northwest field, where Standard Oil Co. of California fee 87-17e, 17-21s-15e, Fresno County, was completed as a gas well in February, but Tide Water Associated Oil Co. 27-16 Jacalitos, in 16-21s-15e, the second well, was completed in July, flowing 614 bbl. of oil daily from sands of the Temblor age. A third well, Standard of California's 81-21e, has extended the field southeast about a mile. This is probably the most important wildcat discovery so far this year.

In Kern County, Rothschild & Bender Oil Operations 2 Sheep Springs, in 17-29s-21e, was completed in September in the Carneros sand of Middle Miocene, flowing 1,000 bbl. daily from pay at 3,456-85 ft. This may be the second most important wildcat discovery.

Only eight of the remaining 22 wildcat discoveries appear to be of commercial importance at this time. They are:

1. Mount Poso-Vedder, discovered by 3-18 D. G. Vedder in 18-27s-28e, completed in February for 125 bbl. from the Vedder sand.

2. Lemare-Eocene, discovered by Amerada Petroleum Corp. 65-15 California Lands Co., in 15-17s-18e, Fresno County; produced from the Eocene but dry in the Temblor, although only 3,000 ft. north of Superior Oil Co. 81 Kreyenhagen in 22-17s-18e, which discovered the Lemare field and produces from the Temblor but not from the Eocene.

3. Tide Water Associated Oil Co. 24-18 Porter, in 18-30s-29e, north of the Mountain View field, flowed 500 bbl. from a sand of Santa Margarita age.

4. Bellevue, discovered by Superior Oil Co. 36-35 Houghton, flowing 1,900 bbl. daily from the Stevens zone. Lies about 4 miles southeast of the Greeley field, along the Rio Bravo-Greeley trend, but appears to be limited in extent as two dry holes and two producers have since been completed.

5. Antelope Plains, discovered by Shell Oil Co. 57X-31 Hopkins fee, in 31-27s-20e, completed in June for 240 bbl. daily flow from an interval of Eocene sand between 2,485 ft. and 2,515 ft.

6. Premier, East, discovered by Independent Exploration Co. 3 Concco in 33-27s-27e, completed in July for 250 bbl. daily flow from an interval of Etchegoin sand between 2,268 and 2,349 ft.

7. Race Track, discovered by the British American Oil Producing Co. 53-3 Portales in 3-30s-29e, Kern County, good for 240 bbl. daily from the Jewett silt of Lower Miocene age, completed in September.

8. Mount Poso-Glide, discovered by Harry Magee on May 11 in his 2-11 Glide in 11-27s-28e, Kern County, producing 25 bbl. daily from the Vedder sand at 1,280-1,300 ft.

New Pool Discoveries and Outpost Successes

During the first 9 months of 1944, 31 successful new pool tests and outposts have been completed, and either one of the largest two of these has discovered far more reserves than the total of all wildcat discoveries during the same period. This is not unlike last year's record. Three of these now pool tests are of substantial importance.

The most outstanding appears to be in the Buena Vista field, where Standard of California fee 27B-54, in 27-31s-23e, opened a new pool at the base of the Pliocene when it was completed in March flowing 625 bbl. daily from the interval at 4,360-4,438 ft. Up to October 1, 23 producers had been completed in this zone, extending production for 3 miles along the Buena Vista anticline, proving approximately 1,400 acres, which at an estimated 25,000 bbl. per acre, adds about 35 million barrels of oil to the state's proved reserves.

In the San Miguelito field, Ventura County, Continental Oil Co. 31 Grubb in 24-3n-24w, opened a new

*District geologist, District 5, Petroleum Administration for War.

pool in sands of the Pliocene age, flowing 1,558 bbl. of oil and 1,600,000 cu. ft. of gas from the interval at 7,225-7,700 ft. This discovery emphasizes again the great potentialities of deeper zones in the fields along the Ventura Avenue-Rincon trend.

In the Seal Beach field, Shell Oil Co., Inc., 5 Bryant in 11-5s-12w, extended the North McGrath pool by flowing 1,600 bbl. per day from an interval of the upper and lower McGrath zones. This well extended the area of North McGrath zone production, which now appears to have proven reserves of about 5,000,000 bbl.

Gas Discoveries

Six wildcat gas discoveries and one deeper zone in the Rio Vista field were found in the first 9 months. All six wildcat discoveries are of commercial importance and four of them may develop into major gas fields. All six were on seismograph surveys. The fields are:

1. Honker field, which lies at the east end of Suisun Bay in Solano County, discovered by Standard of California 1-A Honker Community, in 25-3n-1w, which produced 3,200,000 cu. ft. of gas from an interval of Eocene sand between 7,190 and 7,429 ft., after drilling to a total depth of 8,304 ft.

2. Suisun gas field, lying 6 miles northwest of the Honker discovery, and at the north end of Suisun Bay, discovered by Standard of California 3 Suisun Community in 5-3n-1w. The well was completed in September with an initial of 7,350,000 cu. ft. of gas from intervals at 3,410-90 ft. and 3,500-3,640 ft. An interval between 3,875-3,949 ft., not opened on final completion, flowed 8,000,000 cu. ft. daily on test. Production is probably from Eocene sands.

3. Dixon field, in Solano County, about 12 miles north of the Rio Vista gas field, discovered by Amerada Petroleum Corp. 1 Starkey fee, in 2-6n-2e, completed in August with initial flow of 22,570,000 cu. ft. of gas daily from Eocene sands at 4,550-4,600 ft.

4. Trico, Northwest, in Kings County, about 8 miles northwest of the Trico gas field, discovered by Standard of California 1 Cutter in 29-23s-22e, with initial production of 7,616,000 cu. ft. of gas from a sand equivalent to the "C" zone of Pliocene age in the Trico field.

5. Chico field, in Butte County, about 5 miles southwest of Chico, and the most northerly gas field in California, discovered by Richfield Oil Corp. 1 Chico, with initial production of 3,200,000 cu. ft. of gas from Cretaceous sands at 4,365-90 ft.

6. Afton field, in Glenn County, just east of the Sacramento River, discovered by Richfield Oil Corp. 1-1 Afton Community in 34-19n-1w, with initial production of 4,500,000 cu. ft. of gas from a thin sand near the top of the Cretaceous at 2,648-60 ft.

An important deeper-zone discovery of gas, which may eventually equal or exceed the Buena Vista and San Miguelito new zone discoveries, was made in the Rio Vista gas field by Standard of California H-6 Perry Anderson in 36-4n-2e. The producing interval of Eocene age from 5,735-5,830 ft., is the third gas zone discovered to date in this field. Initial flow was 16,704,000 cu. ft. of gas daily.

Exploratory Activity and Results 9 Months of 1944 vs. 1943

During the first 9 months of 1944, 188 wildcats were completed, compared to 186 during the entire year 1943, an increase of one-third. The footage drilled in 1944 was 820,865 ft. of wildcat hole compared to 798,384 ft. for the entire year 1943. New pool tests and extensions, i.e., exploratory drilling other than wildcats, increased 30 per cent over last year. Total exploratory footage was 1,259,688 ft., compared to 1,203,274 ft. for the entire year 1943.

Reserves Discovered

A rough guess at the reserves discovered in the first 9 months of 1944 indicates that approximately 7,500,000 bbl. of oil may have been discovered by wildcatting. New pool tests and extensions are estimated to have proven reserves amounting to five or six times as much as the wildcat discoveries.

The total reserves of oil discovered in the first 9 months of 1944 is probably less than 20 per cent of the total oil production during the same period. This is about the same as the figure for the year 1943, which was 22 per cent. In other words, we are continuing to use up our reserves five times faster than we add to them.

Nazi Synthetic-Oil Plants Targets of Bomb Raids

LONDON.—Germany's synthetic-oil plants, especially the great Leuna plant at Merseburg, 92 miles southwest of Berlin, are among the principal targets of Allied bombers. More than 1,150 American bombers participated in a recent attack on plants at Merseburg and Homberg, the latter in the Ruhr.

The Leuna plant, which the Germans have been striving to protect, produced 50,000 metric tons of synthetic products each month before October 7, date of the last previous United States attack. One of the largest in Germany, it is nearly 2 miles long and 3,000 ft. wide.

A Homberg attack was designed to break up repairs to the oil plant the Germans were known to have made since the blow of November 1. Great clouds of smoke hid the plant soon after the bombing started. The Homberg plant formerly produced 16,000 tons of oil a month, but its capacity had been reduced about 75 per cent.

B-29 Superfortresses delivered a telling blow last week against Japanese power when they struck at the Pangkalan-Brandon oil refinery on the north coast of Sumatra.

At least one bomb fell squarely on the refinery, the communique said.

W.P.R.A. Demands Full Discussion of Oil Pact

Western Petroleum Refiners Association has adopted a resolution urging the U. S. Senate not to ratify the Anglo-American oil pact in its present form. The pact is characterized as indefinite, ambiguous and vague, and as extending unwarranted federal control of the oil industry.

Declaring the agreement was formulated without free consideration by representatives of the petroleum industry, the resolution urges that, before any part of the agreement is ratified, "all branches of the petroleum industry be given an opportunity for full, frank, and open discussion and recommendation, and that representatives of the industry nominated by its various branches be given a place in the formulation of any such agreement."

Diesel-Engine Makers to Discuss Their Problems

CLEVELAND.—A round-table discussion of problems facing the industry will feature the annual meeting of Diesel Engine Manufacturers Association, to be held here December 6. It will be strictly a business session, according to Robert E. Friend, president of the association and head of Norberg Manufacturing Co., Milwaukee. Issues created by the war will have an important place in the day's program.

R. E. FRIEND

A new activity, that of watching state legislation that may affect diesel-engine interests, will be discussed by Harvey T. Hill, executive director of the association. Committees on public relations, traffic, insurance and education will report. Nine directors will be chosen to serve through 1945. The directors will elect officers and set up the program for next year.

Seated: John H. Baird, Lubri-Zol Sales Co. and chairman, Mid-Continent Section S.A.E.; B. E. Sibley, chief technologist, Continental Oil Co., and C. S. Hansen, chief lubrication engineer, Phillips Petroleum Co. Standing: A. J. Blackwood, research engineer, Standard Oil Development Co., Esso Laboratories; T. B. Rendel, assistant to vice president, Shell Oil Co., Inc., and Earl Bartholomew, director engineering laboratories, Ethyl Corporation

Properties and Performance of New Lube Oils Are Considered

by R. B. Tuttle

MORE than 200 technologists of the petroleum, automotive, and aviation industries heard discussions explaining recent developments in the technology of lubrication at meetings held November 10 and 11 at Tulsa under the auspices of the National Fuels and Lubricants division of the Society of Automotive Engineers. Those who have major responsibilities in lubricating the Allies' military machines discussed the properties and performance of the new oils and outlined the problems yet to be solved.

Speakers also emphasized what needs to be done in educating consumers and service organizations as to the specifications of new lubricants which will be available to civilians after the war's end. Considerable time was devoted to an open discussion as to the most effective methods of educating automotive and industrial users.

Following the registration period which began at 9:30 a.m. Thursday, "A Survey of Past and Present Trends in Lubricating Oil Activities," was presented by W. A. Wright of Sun Oil Co. Carl Georgi, Quaker State Oil Refining Corp., gave the second paper, "Detergency or Dispersancy in Heavy Engine Oils?" at the morning session. The afternoon technical session included "Some Comments on Engine Testing of Heavy-Duty Oils," by Norman C. Penfold, chief engineer of the engine research laboratory, Armour Research Foundation, and "Testing Heavy-Duty Lubricating Oils for Naval Service," by Lt. A. D. Brabbs, U.S. Naval Engineering Experiment Station.

W. S. James, S.A.E. president, spoke on "The Importance of Fuels and Lubricants in S.A.E. Activities," at the Thursday evening meeting, and C. B. Veal, manager and secretary of the Coordinating Research Council gave "A Review of Coordinating Research Council Activities."

The Friday morning technical session opened with Lt. Col. R. E. Jeffrey, Jr., U.S. Army Ordnance Department, presenting "Development of Greases for Military Vehicles." Maj. S. C. Britton, A.A.F. Air Technical Service Command, Wright Field, coauthor with Dr. W. Schlesinger of the same organization, discussed their paper, "Military-Aircraft Grease Lubrication." Pointing out that prior to 1942 a choice of nine greases for Army vehicles was possible under existing specifications, Colonel Jeffrey explained how the nine specifications, under which were listed hundreds of proprietary brands, were reduced to five and finally to four specifications. The elimination of brand name from lubricant containers as a present Army requirement which was put into effect to deemphasize brand names, is pointed out in the paper. In discussing the wide scope of problems in the field servicing of military aircraft, Major Britton stated: "It has been found that practically all requirements for lubrication in the field can be filled with four greases." The four greases listed in the paper may be summarized as: (a) A low-temperature grease for an operating range of —65° F. to +175° F.; (b) an intermediate, general purpose grease for an operating range of —30° F. to +250° F.; (c) a high-temperature, heavy-duty grease for an operating

Seated: W. G. Ainsley, director engine laboratories, Sinclair Refining Co.; Lt. Col. R. E. Jeffrey, Jr., U.S. Army Ordnance Department, and W. G. Clark, chief lubrication engineer, Pure Oil Co. Standing: Norman C. Penfold, chief engineer research section, Armour Research Foundation; Fred Norton, chief engineer lubrication-research department, Ohio Oil Co.; C. W. Georgi, technical director research laboratory, Quaker State Oil Refining Corp., and William F. Lowe, secretary and treasurer of the N.G.A.A.

range of 0° F. to +300° F., and (d) an e.p. grease. These four greases are covered by standardized specifications. How the A.A.F. have simplified the field servicing problems was illustrated with lantern slides which showed the points of lubrication and the type of lubricant to be used for several aircraft.

Friday afternoon the technical session opened at 2 o'clock with "Fuel Requirements of Automotive Diesel Engines - Automotive Diesel Fuels Division, Coordinating Fuel Research Committee." The authors of this paper were F. C. Burk, Atlantic Refining Co.; G. H. Cloud, Standard Oil Development Co., and W. F. Aug, Mack Manufacturing Co. Presented by E. M. Barber, The Texas Co.; E. W. Aldrich, National Bureau of Standards, and A. E. Robertson, Standard Oil Development Co., the paper "The Occurrence of Vapor Lock as Related to the Temperature V/L Characteristics of Motor Gasolines," ended the technical sessions for the 2-day S.A.E. meeting.

Beginning Saturday the Coordinating Research Council, sponsored jointly by S.A.E. and A.P.I., opened its regional meeting which continued through Sunday, November 12. Because many of the technologists attending the S.A.E. meeting were serving on the various committees for the C.R.C., plans were worked out wherein C.R.C. would open sessions immediately following the close of the S.A.E. meeting. This is the first meeting of C.R.C. that has directly followed a S.A.E. meeting; plans are to continue holding the meetings in this order.

The next Fuels and Lubricants meeting is scheduled to be held by the S.A.E. May 16-17, 1945, at Cleveland.

Following are brief digests of the principal points covered in three of the papers presented at the meeting, all dealing with the same general subject:

Function of Heavy-Duty Lubricating Oils

THE primary function of heavy-duty "reinforced" lubricating oils is as a dispersing agent rather than as a detergent, C. W. Georgi, Quaker State Oil Co., stated in discussing the use of additive-treated oils. He pointed out that so-called detergent oils often have strong loosening effect on soft, greaselike engine deposits but do not loosen hard, coky-type deposits sufficiently. Further, a serious danger exists in using strongly detergent-type oils; if too large amounts of sludgy material is loosened rapidly, stoppage of the oil pump flow and therefore of oil circulation with rapid damage to the engine bearing surfaces can be the result. This situation has arisen periodically in the field with disastrous results, Georgi declared.

Heavy-duty oils must be evaluated by experienced observers whose knowledge of masses of evidence from numerous tests can serve as basis for this evaluation, N. C. Penford, Armour Research Foundation, believes. Survey of laboratories testing oils by the CRC designation test shows that diesel-engine tests used currently are satisfactory to screen good from bad oils. The gasoline-engine tests should be developed and amplified further in order to correlate more closely with heavy-duty truck and bus operation, Penfold stated. No bench tests, either chemical, physical or a combination of the two are adequate to evaluate heavy-duty oils for service, but at best can serve to supplement engine tests or as re-evaluation or research tools, he declared. Engine tests must continue for research, testing, and development work with additives, over the entire field, this author believes. Field performance must be used always for final evaluation. Illustrating this use of engines, Penfold stated that some 400 engines are in use in this country exclusively for evaluation of and research on lubricating oils.

Lubricants of the future will be carefully formulated and highly specialized, says W. A. Wright, Sun Oil Co. In spite of special techniques which will be developed, much of the lubrication load will be carried by specialized additive agents. Although test methods may be in some measure idealistic they serve well in obtaining many useful data, Wright believes. Discussing the additive patent situation, Wright said, "It seems quite evident that . . . no effort has been spared to place every type and modification of chemical compound in the record, just in case. . . We are fast approaching the point where rule of thumb and cut and try will fail to yield the advances required." Those manufacturers who first offer the required information on their additives and their use will be rendering a great service and will attain an enviable position in the field of additives. Much remains to be done in clarifying the distinction between detergents and dispersants, Wright says; the ability to "prescribe" for lubricants is very much needed, he implied, and doubtless will be achieved as time goes on. He arranged additives into five classes or types: (1) Antioxidants, (2) oiliness or extreme pressure, (3) pour-point depressants, (4) detergents, and (5) viscosity controllers.

New Regulation Simplifies Oil-Transportation Rates

WASHINGTON.—Maximum rates for transportation of petroleum products in tank truck by contract motor carriers are embodied in a new regulation announced by Office of Price Administration. The new regulation, effective November 16, is in effect a simplified restatement of the regulations that heretofore have covered this transportation service. They were the General Maximum Price Regulation and two of its supplementary regulations, Nos. 14 and 15.

Ceiling prices are not to be changed but remain generally as each operator's highest rate in March 1942 for the same or similar service. Those not in operation in March 1942 take the ceilings of a competitor transporting the same commodities in the same area. Adjustments previously granted remain in effect. Similarly, the ceilings continue that were determined by mutual agreement and reported to OPA.

One important change is made in connection with reports. Within 30 days after the effective date of this new regulation, all carriers covered are required to file with OPA in Washington copies of their schedules of rates in effect in March 1942, or as subsequently adjusted by OPA. A memorandum has to be filed also showing the contracts at present in effect, listing the name and address of each shipper and those portions of the contracts dealing with rates.

Magnolia Posts New Prices For Oklahoma Fields

DALLAS. — Magnolia Petroleum Co. has posted the following prices, effective August 1, 1944, for crude oil purchased in Oklahoma, excluding the Cement pool, in Caddo County, and the Oklahoma City pool, in Oklahoma County: Below 21 gravity, 85 cents, with 2-cent differential beginning with 87 cents for 21 to 21.9 gravity to a top of $1.25 for 40 gravity and above.

Effective on the same date the following prices will be paid for oil purchased in the Cement and Oklahoma City pools: Below 16 gravity 70 cents; for 16 to 16.9 gravity 73 cents, with 3-cent differential to 85 cents for 20 to 20.9 gravity, thence to 87 cents for 21 to 21.9 gravity, with differential of 2 cents to a top of $1.25 for 40 and above.

New Crude Prices Posted By Standard of Louisiana

SHREVEPORT.—Standard Oil Co. of Louisiana has posted for the first time the following prices: Mallalieu, Miss., sweet crude, 24° gravity, 86 cents, with 2-cent differential to a top of $1.18 for 40° and above; Delta Farms, Shuteston and Vacherie (South Louisiana), 20° gravity, 90 cents, with 2-cent differential to a top of $1.30 for 40° and above.

The company increased its posting for Golden Meadow crude 5 cents a barrel, making the new price the same as that now quoted for South Louisiana crudes. It increased the posting for Lisbon, La., distillate 20 cents to a flat price of $1.40. The first posting for Delta Farms is an increase of 5 cents over the price previously paid.

Navy to Start First Well In Alaska Next April

POINT BARROW.—Work on the first well in the Navy's Alaskan oil reserves, about 175 miles east of Point Barrow, will be started next April, according to Rear Adm. C. A. Trexel. Trexel said a permanent base camp, occupied by 200 seabees and naval engineering officers, is virtually complete and the exploratory party expects to leave for the oil area in January.

Knock-Test Problems to Be Discussed at Forums

NEW YORK.—Operation and maintenance problems of knock-test equipment for motor and aviation gasolines will be discussed at forums to be held throughout the country, according to Coordinating Council, Inc. The forums are designed to provide operators and supervisors with practical assistance in helping them overcome day-to-day operating difficulties. One of the features will be a series of slides on "what not to do." Information on changes in equipment and modern operating techniques will be discussed, and ideas which have proved useful in one laboratory will be shared with others.

Dates and places of these forums, with the leader of each, follow: November 27-28, Sylvania Hotel, Philadelphia; J. E. Taylor, Gulf Research & Development Co. November 30-December 1, Palmer House, Chicago; J. O. Elsinger, Standard Oil Co. (Indiana). December 4-5, President Hotel, Kansas City; H. M. Trimble, Phillips Petroleum Co. December 7-8, Rice Hotel, Houston; A. R. Stark, Humble Oil & Refining Co. December 11-12, Richfield Oil Corp. Building, Wilmington, Calif.; H. A. Mason, General Petroleum Corp. December 14-16, California Research Corp., Richmond, Calif.; J. T. Ronan, Shell Oil Co., Inc.

Petroleum Administration for War has approved the forums, which were authorized by coordinating fuel research committee and are under the joint sponsorship of Dr. A. E. Becker, Standard Oil Development Co., director of operation and maintenance projects of the CFR motor fuels division, and J. G. Moxey, Jr., Sun Oil Co., leader of the operation and maintenance group working on laboratory detonation projects of the CFR aviation fuels division. Assisting these men in conducting the forums will be representatives of Waukesha Motor Co., manufacturer of the CFR knock-testing equipment, and a group of men who have had wide experience in knock-test work.

The first day of each forum will be devoted to discussion of the two procedures in general use for testing motor gasolines and one procedure for testing aviation gasolines. Both morning and afternoon sessions will be open to all interested.

The second day will be devoted to discussion of the CFR supercharge method of test for knock characteristics of aviation fuels and the lean-mixture procedure as it relates to testing aviation gasolines above 100-octane number, and an inspection trip to a well-equipped laboratory. Attendance at this meeting is limited to representatives of laboratories operating F-4 engines, or F-3 engines used to test aviation gasolines above 100-octane number.

Technical Men Perform War Marvels, Says Dewey

NEW YORK.—Research chemists, chemical engineers, mechanical engineers, the construction and production men of industry, must be credited primarily with this country's amazing success in technological warfare, declared Col. Bradley Dewey, former rubber director, in his address at the Roosevelt Hotel November 10, accepting the Chemical Industries Medal from the American section of Society of Chemical Industries for valuable application of chemical research to industry.

"How was it possible," asked Colonel Dewey, "for this peace-loving nation to leap from a standing start into a global war and to surpass quickly in both volume and quality the material of war which our dictator enemies had spent years in scheming, planning and producing?

"It was possible, I think, because American free enterprise in time of peace had given us for the time of war the needed teamwork of scientists and technical men and business men which was able to work the miracles of large-scale cooperation.

"The synthetic rubber program, with whose details I am familiar, seems to me to exemplify this teamwork without which we might long ago have become a captive, subjugated people.

"Most of these men who really did the job were working in teams in the laboratories and organizations of large units of American business. While I am from a small business, I emphasize that the big job was done by men with background and experience gained on their jobs with big chemical companies, big rubber companies, big oil companies, etc.

"Thanks to the American competitive system, we had men of resource and intellectual daring, trained and fitted to cope with the new and ever-changing problems of war. We had men out of laboratories and offices accustomed to facing real problems realistically. Surely, these men were far more capable in the emergency of war than they would have been had their only training been in the ivory towers of bureaucracy."

Three Oil Men in Aviation Service Reported Missing

Three young oil men of Tulsa, all members of the same flying crew, were reported this week as missing in action. The father of each is also in some branch of the oil business. The flyers who failed to return from a flight of the bomber "Take Me Back to Tulsa" on October 29, in the Mediterranean theater, were Second Lt. Sidney R. Davis, petroleum engineer, pilot of the plane; Second Lt. Floyd N. Martin, worked for Sunray Oil Co., but attending school at time of his enlistment, co-pilot; Second Lt. William J. Connelly, employed by Larkin Torpedo Co., bombardier.

The father of Lieutenant Davis is Sidney H. Davis, an independent operator and vice president of Ozark Chemical Co. Lieutenant Martin's father is F. L. Martin, vice president of Sunray. Lieutenant Connelly's father, Ernest L. Connelly, is secretary-treasurer of Larkin Torpedo Co.

Progress Made in Efforts To Equalize Crude Prices

WASHINGTON. — "Satisfactory progress" was reported by Gov. John J. Dempsey, of New Mexico, last week in his efforts to equalize New Mexico and West Texas crude-oil prices.

"I had a very satisfactory interview with Fred D. Vinson, economic stabilization director, and I will take up the subject with Office of Price Administration," Dempsey said.

Prices for New Mexico crude are now more than 10 cents a barrel under those for West Texas, Dempsey explained. This differential costs the state from $11,000 to $13,000 a day, as much of the crude comes from state and federal-owned lands.

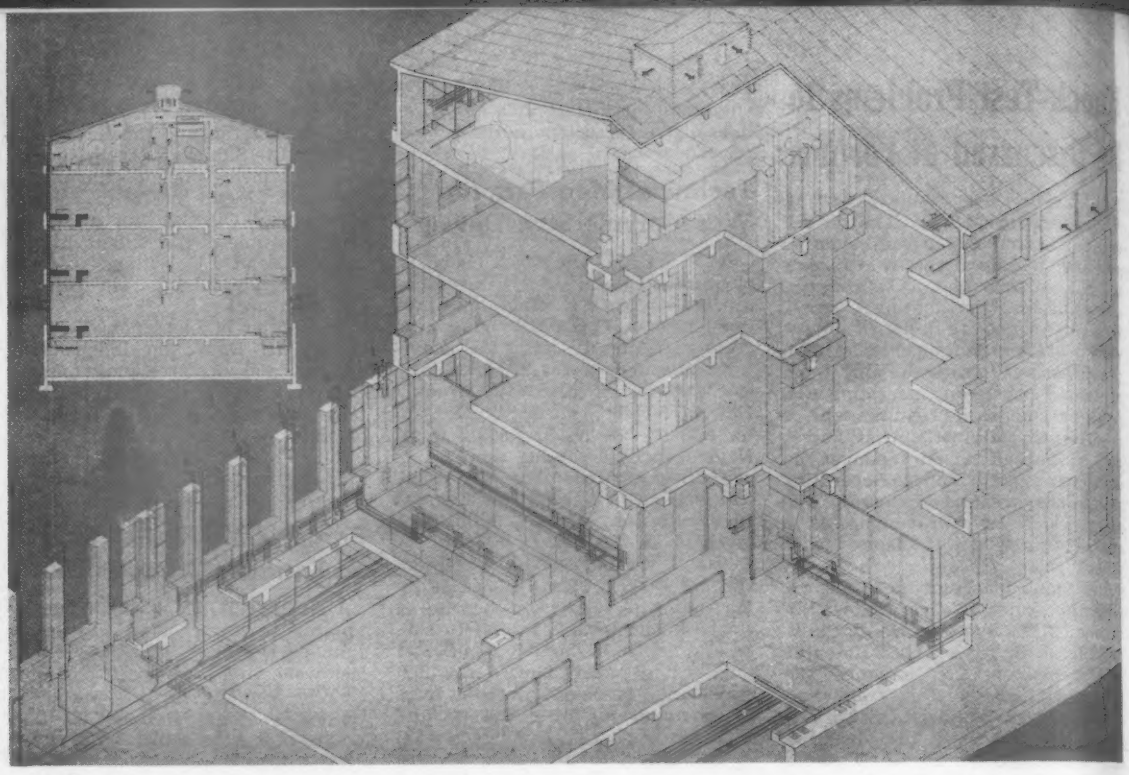
DEATHS

J. C. Burnham, 31; **James W. Manning**, 45, and **Vernon G. Hill**, 43 all residing in Houston and employed as rig builders by Sherwood Clark Co., met almost instant death November 6 in an automobile accident on the Beaumont highway. Burnham for 6 years had been chief crew pusher.

George E. Willits, head of George E. Willits & Son., drilling contractors, died at Bothwell, Ont., November 8. He had drilled in South America and carried out numerous contracts in the southwestern Ontario fields.

Even S. Vickery, 54, oil producer and drilling contractor, died in Bradford, Pa., November 10. He had operated in Pennsylvania, Texas, and Oklahoma. As a young man, Vickery was a pitcher in the Interstate Baseball League.

Charles W. Mullaley, 69, independent oil and gas producer, died November 9 in Shreveport.



Cutaway section showing disposition of services and their availability to the 6-ft. module unit. The balanced system of ventilation is illustrated. When laboratories require fume hoods, exhaust is through hood

FACTORS IN DESIGN OF RESEARCH LABORATORY

by Charles Haines

UNDER the stress of wartime demands, the oil industry has crowded a decade or more of progress into a few years. New products and new processes have been developed which have doubtful peacetime applicability. This progress has not been orderly and has been achieved without regard to economics. One of the tasks facing it is to find commercial application for the production facilities added during the war to reduce the war-justified cost of new products to a peacetime economic level.

The pursuit of the tremendous possibilities in the field of petroleum research has resulted in further crowding the already taut research facilities. This is borne out by personal inspection of a few of the leading laboratories in the industry. This article describes a typical industrial laboratory with particular reference to requirements that are applicable to the oil industry. Actually, the only distinctive difference between a petroleum-research laboratory and any other is the need for accommodating pilot plants that may be of unusual height.

Growth of the Control Laboratory

Many years ago the function of the laboratory was to provide analyses of the various raw materials and to test the product in order to maintain standardization. For such a purpose a corner of the factory, shop, or office was allocated and the chemist or physicist set up shop with whatever glassware and testing equipment he could obtain that would suit his purpose. As the business expanded more permanent fixtures were purchased, more services were piped and more space added.

In recent years a more radical change has come about in research methods. Scientific investigation is no longer the trial-and-error effort of a single individual or small group, but it has become the organized so-

CHARLES HAINES

Prewar research and development work were responsible for the petroleum industry's ability to move quickly into the large-scale manufacture of war products. Operating companies and those serving the petroleum industry with processes and equipment have plans to continue this work on greatly expanded basis in the postwar period. In this article the author describes one of the largest of the new research laboratories serving the industrial field. The description is presented here because the principal features in building design are applicable to the petroleum industry.

The author is connected with Voorhees, Walker, Foley & Smith, architects and engineers, New York City, and since 1938 has devoted his time almost exclusively to laboratory design. He has had a part in the design of several industrial and university laboratories. He is a graduate in engineering of University of Kansas and the School of Architecture, Columbia University.

Services to wall laboratory tables are simply supported on inserts in the steel partitions. Note in the photograph at right, above, the horizontal power raceway, fed from a power riser and circuit-breaker assembly. Chemical laboratories are provided with a secondary means of escape. This panel may be seen in lowered position in the picture at left, above. In the picture below, an 18-ft. or three-module laboratory is seen with benches removed to show support of services on partition walls, and services for island tables. In the corner is a typical fume hood

lution of problems in which time is a new factor.

The research problem is organized into its various aspects and programmed to achieve predetermined results on schedule. The director is then provided with adequate staff and facilities, commensurate with time, economy, and importance of the task. However, he must also be provided with the space to do this job.

So we see that specially designed space is not in itself adequate; in addition it must have the characteristics of flexibility and adaptability in order to keep pace with the needs of the organization.

Modern Laboratory Design

In order to achieve a laboratory having the required functions the design must be measured against the following criteria.

Qualities of space

Adequacy without being wasteful.

Good natural and artificial illumination.

Satisfactory natural and mechanical ventilation.

Ease of rearranging partitions.

Durability.

Cleanliness by avoiding dust-collecting surfaces.

Cleanable surfaces.

Safety of a high order.

Colors, selected to promote cheerfulness and prevent eye strain.

Reduction of sound transmission and reverberation.

Qualities of plan

Interchangeability of furniture through unit design.

Ready rearrangement of furniture by use of service strips for mounting mechanical services.

Simple and inexpensive means of providing unanticipated services.

Convenience to office space, clerical help, and conference rooms.

Adjacency of service of supply, such as stock rooms, shops,

glass blowing, glass washing, mail, messengers and library.

Segregation of visitors' and employes' entrances.

Segregation of the circulation of things and the circulation of people.

Adequacy of storage facilities.

Convenience of medical and first-aid services.

Qualities of amenities

Provisions for lunching facilities including supplementing the carried lunch, cafeteria, restaurant and sandwich bar.

Convenience and character of lockers and rest rooms.

Recreational facilities.

Exterior design of dignity and character.

Landscape design suitable to the site and structure.

Suitable parking with convenience.

While the above specifically refer to laboratories of bench scale, the space for testing and pilot plants must meet the same criteria with different standards which must be established by the owner and the architects. For example, the degree of hazard and the extreme height of long-contact reactors or fractionation columns in a pilot plant would indicate the need of a separate building. On the other hand a number of pilot plants all having different requirements can be housed together in a single-storied structure. This structure could be compartmented or open, arranged to provide constant temperature and humidity control for testing or process control; catwalks and steel-grating floors may be located at almost any desired level, as well as adequate supports for modifying the equipment by installing structural steel at convenient intervals arranged with slotted connections in much the same manner as the common adjustable bookshelf.

A Solution

A few years ago, Bell Telephone Laboratories, Inc., began construction of a typically modern laboratory and a description of it illustrates well the principles outlined above.

The building is three stories in height and approximately 56 ft. in width with a center row of columns. By placing the aisle on one side of the columns two depths of space were obtained, one 25 ft. and a narrower one of 19 ft.

A survey of the space requirements showed that nearly a fourth of the area needed was made up of private offices, clerical space, group design offices, drafting rooms, and conference rooms. Since no mechanical services were required for this type of space it was felt that considerable saving might be effected by segregation of these functions; on the other hand none of these functions could be very far from their associated laboratories.

The basic plan then became a "T" in which the offices were located in the stem with the laboratories forming the arms. Since stairs and toilets did not require natural light these were located at the junction.

The laboratory space is laid out in units or modules of 6 ft. each. Each is complete having its own window, lighting fixture, radiator, mechanical and electrical services, telephone outlets and space for a metal partition. Thus a laboratory of any width that is a multiple of 6 ft. may be arranged.

The illustrations serve to show repetitive characteristics of the module both of the laboratory types and the office type, the latter being 8 ft. in width.

The mechanical services are distributed horizontally from their sources in either the attic or the cellar. In general the gases were allocated to the attic and liquids to the cellar. In the chemistry laboratories which comprise two of the six "T" sections the following services are generally distributed; drains, 120-208-v. alternating current; telephone and intercommunication wiring; illuminating gas; hydrogen; oxygen; nitrogen; compressed air; vacuum; steam at 5 lb., 50 lb. or 125 lb.; hot and cold distilled water. These services rise from the mains on 24-ft. centers and are distributed horizontally at each floor level with outlets on 6-ft. centers. The distribution on each floor is under the window and in front of the radiator. The structure, radiator and services are then covered with a skin of metal removable wainscot which is finished in an automobile-type paint, factory applied. By this means, service may be extended to any bench or piece of equipment without unsightly and dirt-collecting overhead distribution. Island benches and pieces of isolated equipment are connected by means of troughs laid in light concrete between the structural slab and the finished floor. Standard wall benches are fed through apertures in the wainscot with services fastened to the partition. Thus there is flexibility in room size and layout due to the movable metal partitions, the availability of services and the use of partitions for supporting the services. By standardizing laboratory-furniture dimensions, and by avoiding the fastening of services to the furniture a great variety of layouts is possible.

The metal partitions are built up of rolled-steel frames 3 in. thick on which are stretched 20-gage furniture steel sheets. The interior of the panel is packed with mineral wool.

The resulting panels are set up and connected by means of stamped steel separators about 3 in. in width. The resulting space is used for electric wiring, support for shelves, service piping, supports for laboratory equipment. The partition is completed by adding snap-on covers for this space, a base and a cornice molding. The door units are the same width as the standard wall panels, and are completely interchangeable.

The building has a cellar and an attic. Not only has the unfinished space satisfied the requirements for an array of special equipment, but since the human being is a squirrel at heart and the scientist especially so, there is a tremendous need for storage space which is cheap and accessible.

The ventilating equipment for tempering, supplying air to and exhausting air from each chemical laboratory, is located in the attic. When the laboratory has a hood the exhaust from the room is by this means. By supplying slightly less air than the exhaust air quantity, a negative pressure is maintained and the odors arising from one laboratory are not mingled with those of another. The savings in capital cost with this arrangement together with the improvement in air quality, more than offset the advantage of economy of operation through control by the individual scientist over the operation of his hood fan.

Supplies enter at the end of one wing. After unpacking, they are taken to the stock rooms which are disposed near the elevators, by trucking through the attic or cellar.

The restaurant and cafeteria are entered through an attractive game room and lounge. A so-called quick-lunch room is placed in another section of the building.

Just as petroleum research requires barreled samples and blending facilities, which are unsightly at best, this laboratory needed space for outdoor tests, experimental antennae, bulky material storage. This area is located in a convenient "back yard." Simple landscaping disguises rather than hides this potential eyesore.

Economy of Planning

What does it cost? Anyone can appreciate the value of planning, and the cost of a well-planned structure is no more than one that is not well planned. The owner has to realize that no one can guess his needs and that the architects and engineers can only assist in speeding and directing this job. The client needs space and needs it quickly, yet the time differential between careful planning and little or no planning is so incidental to the lengthy construction and occupancy periods that it can be ignored. The laboratory illustrated happens to be quite large. The same care should be given a small building. The technique of sound planning is readily adaptable to laboratories of every size. Of all people, the scientist is

Properties of Water Found in Reservoirs

PART 3 OF A SERIES

by Park J. Jones *

Mechanics of Producing Oil, Condensate, and Natural Gas

Water figures in production from the time of discovery down to abandonment. Some properties of the water found in reservoirs vary primarily with the quantity and type of the salts dissolved in water. As water is compressible and expands when heated, the space occupied by water in reservoirs varies with pressure and temperature. At high pressures the solubility of gas in water probably should be considered. The viscosity of water is less than 0.3 centipoises at temperatures greater than 200° F. The correct interpretation of electric logs as to water contacts and water saturation in pay depends, among other things, on the resistivity of water. Resistivity of water varies with temperature and with the quantity and type of the salts dissolved in water.

THE salinity of the water found in reservoirs ranges from less than 10,000 p.p.m. to more than 200,000 p.p.m. The salinity of sea water averages about 35,000 p.p.m. Salinity used in the foregoing sense means total solids in water. Parts per million is by weight. For example, 10,000 p.p.m. of NaCl means there are 10,000 lb. of common table salt in 1,000,000 lb. of a given water.

Salts soluble in water can give positive and negative ions. The positively charged ions are called positive radicals. The negatively charged ions are called negative radicals. Because of ionization, chemists do not agree on how the radicals found in water should be combined. So, instead of reporting NaCl, for example, they report Na and Cl separately. The other radicals found in water are also determined and reported as such. This is called the ionic form of reporting water analyses. Some reservoir waters have more than 20 ionic constituents. Some properties of water vary considerably because of the variation in the quantity and type of ionic constituents.

Density, Specific Gravity and Volume

The density of water is its weight in pounds per cubic foot of volume. At standard conditions, 14.73 p.s.i.a. and 60° F., the density of pure water is 62.34 lb. per cu. ft. Specific gravity is a relative measure of density. The specific gravity of water is its density divided by 62.34. The specific volume of water is the cubic feet of space occupied by 1 lb. of water. At standard conditions, the specific volume of pure water is 0.01604 cu. ft. per lb. The relationship between the foregoing quantities is represented by:

$$S = \rho/62.34 = 1/62.34V$$

$$= 0.01604\rho = 0.01604/V \quad (1)$$

where

S = specific gravity
ρ = density, lb. per cu. ft.
V = specific volume, cu. ft. per lb.

The constants for converting gallons and barrels to cubic feet are as follows: 7.48 gal. per cu. ft. and 5.615 cu. ft. per bbl. The constants for converting weight are 8.334 lb. per gal. and 350 lb. per bbl.

Volume Factor for Water

Water is found in reservoirs at pressures and temperatures greater than those at standard conditions. As water is compressible, it expands upon reduction in reservoir pressure. As water expands when heated, it contracts upon cooling when produced. Changes in volume caused by changes in pressure and temperature may be expressed either on a pound basis or a barrel basis. The barrel basis is much more convenient for field purposes. In this work, the volume of fluids in reservoirs will be expressed in terms of barrels. The number which converts surface volume to reservoir volume is called a volume factor.

The volume factor for water is the space occupied by 1 bbl. of water. For example, a volume of 1.1 means 1 bbl. of water measured at 60° F. and 14.73 p.s.i.a. occupies 1.1 bbl. of space in a reservoir.

The relationship between a volume factor for water and its specific gravity, density, and specific volume is defined by:

$$b = S_o/S = \rho_o/\rho = V/V_o \quad (2)$$

where

b = volume factor, bbl. space per bbl. water

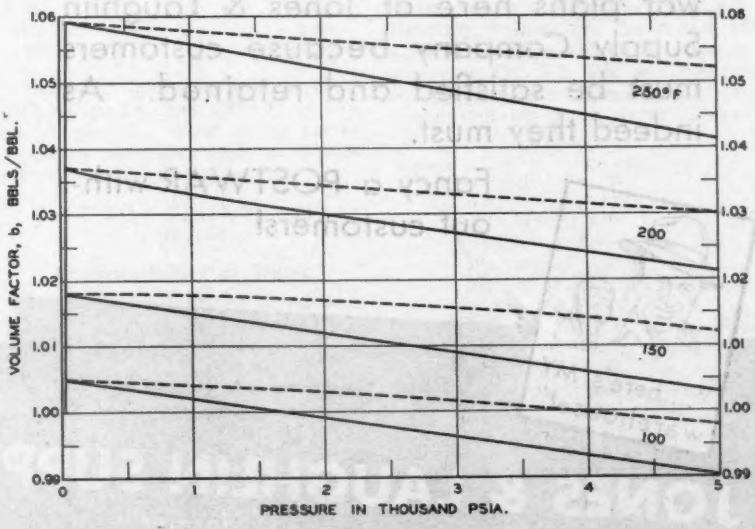


Fig. 3-1: Volume factor for pure water, solid curves, and for pure water saturated with natural gas, dashed curves. After Dodson and Standing

*Production consultant, Houston.

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The subscript refers to standard conditions.

Fig. 3-1 shows how the volume factor of pure water, and pure water saturated with natural gas, varies with pressure at a given temperature. The slope per unit of space of the curves in Fig. 3-1 is called compressibility. Fig. 3-2 shows how the

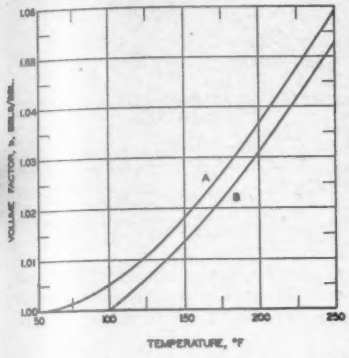

Fig. 3-2: Volume factor: (A) pure water at vapor pressure and (B) pure water saturated with natural gas at 4,000 p.s.i. After Dodson and Standing

volume factor of pure water, and pure water saturated with natural gas, varies with temperature. The slope per unit of space of the curves in Fig. 3-2 is called thermal expansion. Thermal expansion at a given pressure is defined by:

$$E = \frac{1{,}000{,}000\ \Delta b}{b\Delta T} \qquad (3)$$

where

E = thermal expansion, bbl. space/°F./million bbl. space
b = volume factor, bbl. space/bbl. water
$\Delta b/b\Delta T$ = change in space/°F./unit space

Thermal expansion of the water found in reservoir varies from about 100 bbl./°F./million bbl. at standard conditions up to 500 bbl./°F./

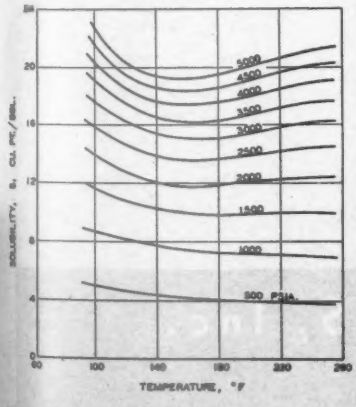

Fig. 3-3: Solubility of natural gas in pure water. Apply correction for salinity. Data by Dodson and Standing

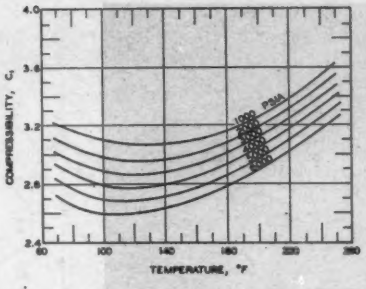

Fig. 3-4: Compressibility of pure water, bbl./p.s.i. million barrels. Apply correction for gas solubility. Data by Dodson and Standing

million bbl. at high reservoir pressures and temperatures. It depends on the salinity of water and the quantity of gas dissolved in water.

Solubility of Natural Gas in Water

The solubility of natural gas in pure water is shown by the data of Dodson and Standing in Fig. 3-3. The solubility of natural gas in the water found in reservoirs is less than in pure water because of salinity. The following expression may be used to estimate the solubility of natural gas in reservoir water:

$$S = S_1\,(1 - XY/10{,}000) \qquad (4)$$

where

S_1 = solubility in pure water, cu. ft. per bbl. from Fig. 3-3
X = correction factor for salinity, see below
Y = salinity of water, p.p.m.
S = solubility of gas in reservoir water, cu. ft. per bbl.

The following correction factors, X in Equation 4, are suggested by Dodson and Standing:

Temp. (°F.)	Value of X
100	0.074
150	0.050
200	0.044
250	0.033

Example: Solubility in pure water at 3,000 p.s.i.a. and 200° F. is 15.4 cu. ft. per bbl. What is the corresponding solubility for a 60,000-p.p.m. water? Solution:

$$S = 15.4\,(1 - 0.044 \times 6) = 11.3 \text{ cu. ft./bbl.}$$

Compressibility of Water

The compressibility of water at a given temperature is defined as follows:

$$C = -\frac{1{,}000{,}000\ \Delta b}{b\Delta P} \qquad (5)$$

where

C = compressibility, bbl. space/p.s.i./million bbl.
b = volume factor, bbl. space/bbl. water
$\Delta b/b\Delta P$ = change in space/p.s.i./unit space

The compressibility of pure water at various pressures and temperatures is shown by the data of Dodson and Standing in Fig. 3-4. The compressibility of water containing gas in solution may be estimated by applying the following correction suggested by Dodson and Standing:

$$C = C_1\,(1 + 0.0088\,S) \qquad (6)$$

where

C_1 = compressibility of pure water
S = solubility of gas in water, cu. ft. per bbl.
C = compressibility of water containing gas in solution

Reacting Values

A water analysis is commonly reported in (1) parts per million of each positive and negative radical, (2) per cent reacting value and (3) properties of reaction. Per cent reacting values are computed from parts per million and equivalent weight. The equivalent weight of a compound, element, or ion is its atomic or formula weight divided by its valence. The equivalent weight of the more common radicals found in water is listed in Table 3-1. According to Table 3-1, 23 lb. of sodium will react with 35.4 lb. of chloride. And so on for any other positive and negative radical listed in Table 3-1.

TABLE 3-1—EQUIVALENT WEIGHT OF SOME RADICALS

Positive Radicals	
Calcium, Ca	20.0
Magnesium, Mg	12.15
Potassium, K	39.1
Sodium, Na	23.0
Negative Radicals	
Bicarbonate, HCO_3	61.0
Carbonate, CO_3	30.0
Chloride, Cl	35.4
Sulfate, SO_4	48.0
Sulfide, S	16.0

An illustrative computation of reacting values is shown in Table 3-2. Reacting values may be presented graphically on a Tickell diagram as shown in Fig. 3-5. The per cent reacting value is independent of contamination by fresh water. There-

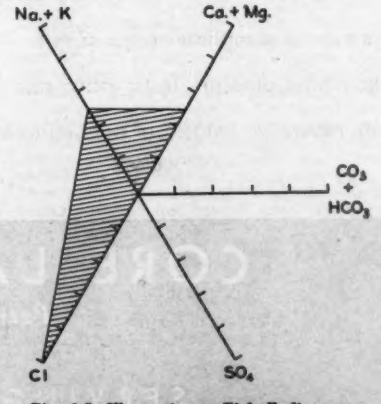

Fig. 3-5: Illustrating a Tickell diagram

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TABLE 3-2—ILLUSTRATIVE COMPUTATION OF REACTING VALUES

Constituent	P.p.m.	Equivalent weight	Equivalent p.p.m.	Reacting value, per cent
Na	48,656	23.0	2,113	25.66
Ca	21,334	20.0	1,067	13.00
Mg	11,345	12.15	930	11.34
SO_4	683	48.0	14	.17
Cl	145,200	35.4	4,080	49.78
CO_3	132	30.0	4	.05
Fe-Al	52	...	....	....
Si	28	...	....	....
	227,430	....	8,208	100.00

TABLE 3-3—APPROXIMATE SALINITY AS NaCl

Primary salinity, NaCl	1.00
Primary salinity, Na_2SO_4	0.40
Secondary salinity	0.37
Primary alkalinity	0.50
Secondary alkalinity	0.27

fore, per cent reacting values and Tickell diagrams are used for comparing water from two or more sources.

Properties of Reaction

The properties of reaction of a reservoir water are named according to the Palmer system, as follows: (1) Primary salinity, (2) secondary salinity, (3) primary alkalinity, and (4) secondary alkalinity. These properties are determined by the following rules:

1. Primary salinity.—Sodium and potassium plus an equivalent value of sulfate and chloride.

2. Secondary salinity.—Sulfate and chloride in excess of sodium and potassium plus an equivalent value of calcium and magnesium.

3. Primary alkalinity. — Sodium and potassium in excess of sulfate and chloride plus an equivalent value of carbonate and bicarbonate.

4. Secondary alkalinity.—Calcium and magnesium in excess of sulfate and chloride plus an equivalent value of carbonate and bicarbonate.

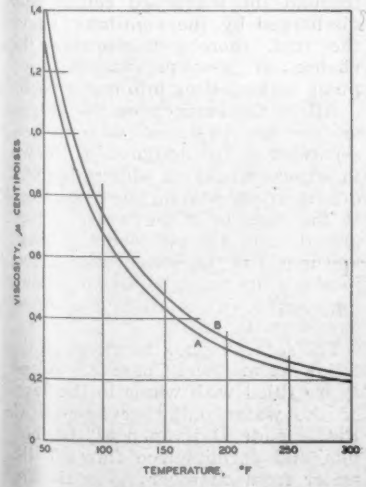


Fig. 3-6: Viscosity vs. temperature for (A) pure water and (B) water containing 60,000 p.p.m.

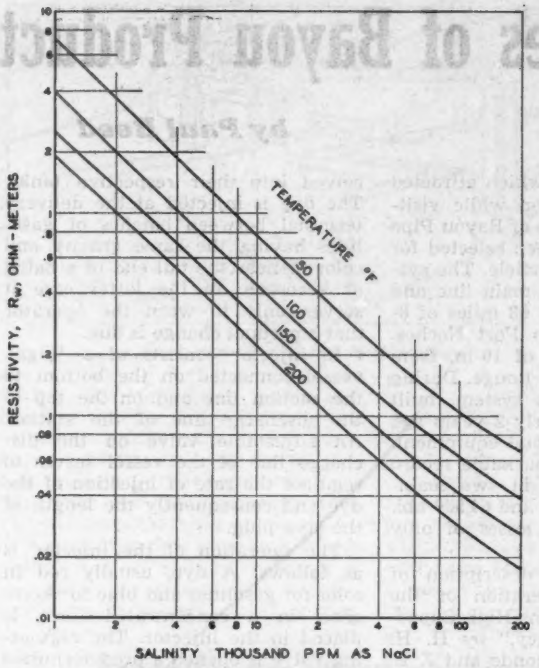


Fig. 3-7: Resistivity of water vs. salinity and temperature

It can be verified by the foregoing rules that the properties of reaction corresponding to the reacting values shown in Table 3-2 are as follows:

	Per cent
Primary salinity	51.32
Secondary salinity	48.58
Primary alkalinity	None
Secondary alkalinity	0.10
Total	100.00

Viscosity of Water

The viscosity of a fluid is a measure of its resistance to internal shear. The units used to express viscosity are not consistent. If the centipoise were used exclusively as the unit of viscosity, there would be less confusion. In this work, viscosity will be expressed in centipoises. Fig. 3-6 shows how the viscosity of water varies with temperature. Salinity slightly increases the viscosity of water.

Resistivity of Water

The correct interpretation of electric logs as to water contacts and quantity of water in pay depends, among other things, on the resistivity of water. Resistivity of water is the specific resistance of water to the flow of electricity, that is:

$$R_w = RA/L \qquad (7)$$

where

A = cross-sectional area, meters
L = length, meters
R = resistance, ohms
R_w = resistivity of water, ohm-meters

Resistivity of water varies with (1) temperature, (2) quantity of salts in water, and (3) type of salts in water. Fig. 3-7 shows how much resistivity varies with temperature and NaCl salinity. Within the range of the conditions existing in the field, resistivity of water can vary a hundredfold.

Table 3-3 gives the approximate salinity of the properties of reaction in terms of NaCl salinity. Application of Table 3-3 and Fig. 3-7 may be illustrated by the following example. A water contains 20,000 p.p.m. of each property listed in Table 3-3. Estimate the resistivity of the water at 200° F. The total salinity is 100,000 p.p.m. but the salinity as NaCl is:

$$20{,}000\ (1 + 0.4 + 0.37 + 0.50 + 0.27)$$
or 50,800 p.p.m.

In Fig. 3-7, the resistivity corresponding to 200° F. and 50,800 p.p.m. as NaCl is about 0.045 ohm-meters.

References

1. Dodson and Standing, A.P.I. Paper 801-20A, presented at A.P.I. meeting, Los Angeles, Mar. 1944.

2. Dole, M., Experimental and Theoretical Electrochemistry, McGraw-Hill Book Co.

3. Handbook of Chemistry and Physics, 28th Ed., 1944.

4. International Critical Tables.

BOOKS

SUMMARIZED RECORDS OF DEEP WELLS. Vol. 16, 1944, West Virginia Geological Survey. By R. C. Tucker. 938 pp.

This report contains a summarized record of 1,350 wells in West Virginia and 250 in bordering states, all of which penetrated to the top of the Onondaga lime or deeper. Accompanying the report are two maps, one showing the location of all such wells on the Charleston, Kenna, and Ripley quadrangles, and the other showing such wells for the entire state. The report furnishes an important and reliable guide for future deep drilling. Included in the well record are the locations of several wells which are being drilled to the Oriskany sand. In a few cases, wells are included which started for the Oriskany but were stopped short of that horizon by obtaining large gas production in shallower sands. As they had been spotted on the maps, it was thought best to still include them in the report, since they may be deepened after producing from the upper sands for a while.

Devices of Bayou Products Pipe Line

by Paul Reed

SEVERAL devices, which attracted particular attention while visiting pumping facilities of Bayou Pipe Line System, have been selected for presentation in this article. The system has 300 miles of main line and feeder line, including 68 miles of 8-in. from Baytown to Port Neches, Tex., and 183 miles of 10-in. from Port Neches to Baton Rouge. During a recent month, this system, built as a war facility nearly 2 years ago largely of junk pipe and equipment, has achieved the remarkable record average throughputs in two main-line sections of 42,407 and 64,569 bbl. daily, with over-all losses of only 0.12 per cent.

A comprehensive description of construction and operation of the system, "Bayou Attains High Capacity in War Emergency," by H. H. Anderson, C. E. Dolhonde and J. L. Rittiner, appeared in The Oil and Gas Journal, September 23, 1943.

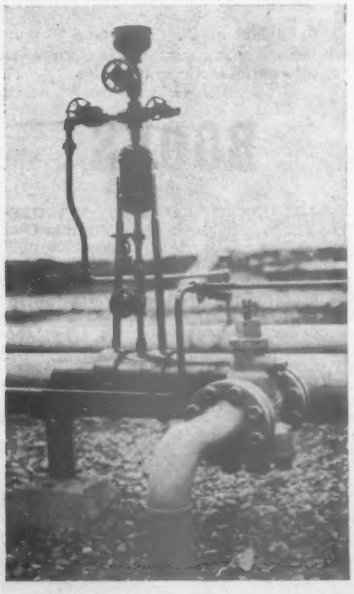
For the purpose of clearly defining the heads and tails of successive batches, special equipment is used for injecting dye and for comparing colors of different batches.

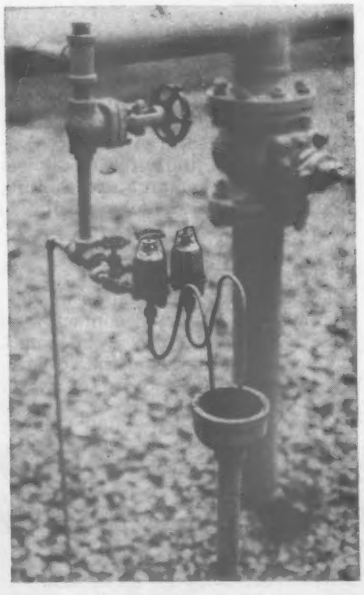
A type of "dye injector" is used on the Bayou system similar to those on other petroleum-products pipe lines for injecting a gasoline-kerosene soluble dye in the flowing stream, thereby aiding the operator at the receiving terminal to properly switch the different products received into their respective tanks. The dye is injected at the delivery terminal between batches of gasolines having the same gravity and color or near the tail end of a batch of kerosene. In the latter case it serves only to warn the operator that a product change is due.

In injector consists of a ½-gal. vessel connected on the bottom to the suction line and on the top to the discharge line of the station. An adjustable valve on the discharge line of the vessel serves to regulate the rate of injection of the dye and consequently the length of the dye plug.

The operation of the injector is as follows: A dye, usually red in color for gasolines and blue for kerosene, in a concentrated form, is placed in the injector. The regulating valve is opened a predetermined amount, and the station discharge pressure is admitted, thus forcing out dye at desired time and rate.

An apparatus called a "color comparer" has been devised by the Bayou system which serves to notify the operator that a product of different specifications, one of which is color, from that being received, has arrived at the terminal. This consists of two inverted automobile fuel-pump cleaning bowls connected at the inlet side to the terminal receiving line and at the outlet side to the terminal sump tank.





Left: Dye injector installed on station piping. Right: Color comparer to aid in determining arrival of tenders of refined products

When a change in products of different colors is expected, the operator fills one of the bowls with the flowing product. A continuous stream is bled at a slow rate through the other bowl until a change in color is observed by comparison, at which time the receiving tanks are switched.

To solve the problem of ventilating heavily loaded electric centrifugal pumps, a positive induced-draft ventilating system at Bayou pump stations was developed to effectively reduce the dangerously high electric-motor temperatures caused by the load conditions and local recirculation of the hot discharge air from the motor.

Ducts are built around each motor to provide an air-tight passageway for the air to travel from the motor air discharge to the station attic. An 11,000-c.f.m. fan-type roof-mounted ventilator takes suction from the attic and discharges the air into the atmosphere. By preventing recirculation of hot air from the motor in the pump room, the motor inlet air temperature is always the same as that of atmosphere. The temperature of the motor outlet air was reduced 30° F.; i.e., from 160° to 130° F. as compared to conditions before the ventilators were installed. The motor-room temperature was lowered from 120° to 89° F.

The plan of making the station attic a part of the ventilating duct system has a further advantage in that some air is drawn continuously from the pump room into the attic through the wallboard ceiling and discharged by the ventilator above the roof, thereby minimizing the chance of gasoline vapors from pump leaks getting into motor room.

All of the stations on the Bayou system are equipped with water-separator boxes designed as shown in an accompanying illustration. All drains in the station are connected to this box. In it the water is separated from the petroleum product and is run to the sewer system. The products are collected in an adjoining sump tank and are later pumped back into the line.

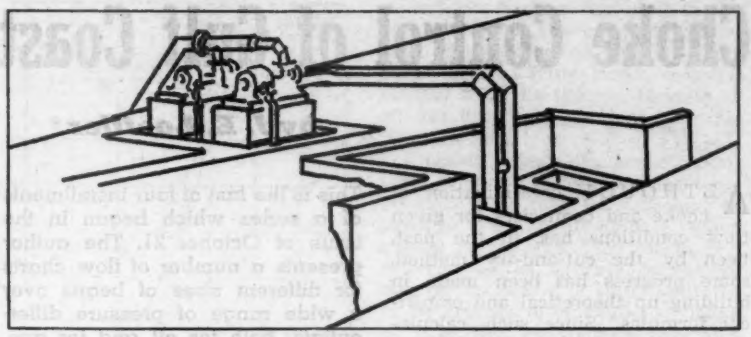
The separator box functions in the following manner: Chambers A and B are filled with water to the level of the water outlet connection C. Baffle plate D is open at the bottom and permits free flow of the water from chamber A to B. The product drain E is located in chamber A at a higher level than water outlet C. All of the liquid flowing

from the drains passes through a screen basket into chamber A.

If a batch of gasoline is received in chamber A, the water level recedes in that chamber and the column of water in chamber B supports the water plus gasoline in chamber A until the level of gasoline is equal to the level of the gasoline outlet connection, at which point it flows into the sump tank. If a batch of water is received, the water levels in the two chambers tend to equalize, thereby causing practically all of the gasoline to flow into the sump tank. The additional water that is received flows out of connection C. If a combination of water and gasoline is received, the described operations occur simultaneously.

Two of the stations on the Bayou system are equipped with automatic storm-pump installations to prevent equipment damage during the heavy flush rains that flood the surrounding area with water. The principal parts of the installations and their operations are as follows:

An earthen dike completely surrounds the station grounds. In a remote corner a pond is located which collects, by means of suitable ditches, the rain water which has fallen within the dikes. Two motor-driven centrifugal pumps, each having a capacity of 1,000 g.p.m., are connected in parallel and take suction from the pond through foot valves. When the level of the water in the pond reaches a predetermined height, a float switch energizes a solenoid valve connected to the domestic water system which primes the pumps.



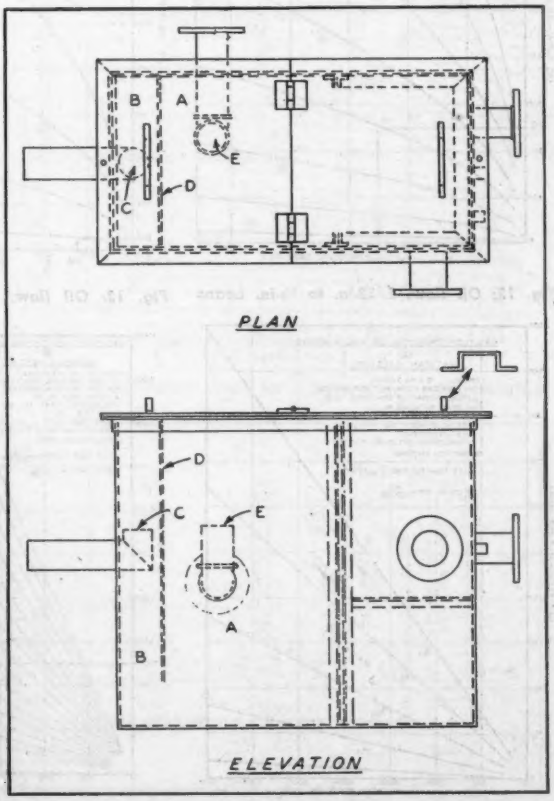
Storm-pump installation to protect main pump station

An automatic air-release valve is located on the case of each pump to bleed the trapped air from the pump volutes. As the level of the water rises in the pond, one pump is started. If the capacity of this pump is not sufficient to reduce or maintain the same level of the water in the pond, the second pump is started. Since the combined capacity of the pumps is large enough to handle the greatest rainfall recorded in that area, the water level in the pond must necessarily recede. Both pumps are stopped simultaneously when the low water level is reached.

The size of the pond and the level at which the float switches energize the motors have been selected so that enough water is present in the pond to assure a minimum operating period of 20 minutes for one or both pumps.

A smaller, auxiliary engine-driven pump also is connected into the manifold in the event a power failure should occur at the time of a heavy rainfall.

Left: Ventilator on pump-building roof. Below: Ducts around main-line pump station electric motors providing for induced-draft circulation of air.



Right: Separator boxes for separating refined products from water

Choke Control of Gulf Coast Wells—No. 4

*by J. E. Loeffler**

This is the last of four installments of a series which began in the issue of October 21. The author presents a number of flow charts for different sizes of beans over a wide range of pressure differentials, both for oil and for gas. Hydrate formation, freezing effect, typical heater arrangements, and approximate temperature drops in throttling are discussed and illustrated.

ALTHOUGH determination of choke and bean sizes for given flow conditions has, in the past, been by the cut-and-try method, some progress has been made in building up theoretical and empirical formulas. Since such calculations must consider many factors and theoretical assumptions, it is intended to present here only data and charts pertaining to fluid flow through the beans themselves.

The pressures given on accompanying charts are the differential pressures across the chokes, whether surface or bottom-hole types. This differential pressure is essentially that between the tubing and the separator, when considering surface application, and for bottom-hole installations, that between the formation and the tubing.

*Chief engineer, Thornhill-Craver Co., Houston.

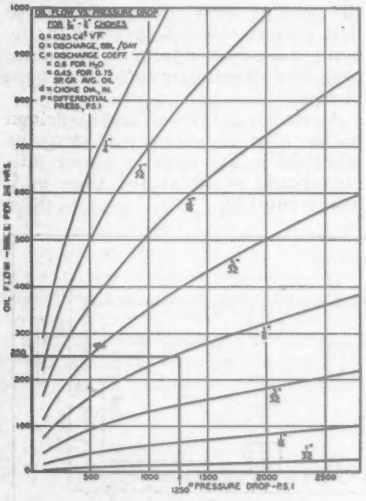

OIL FLOW VS. PRESSURE DROP
FOR ¼" - 1" CHOKES
Q = 1025 C d² √P
Q = DISCHARGE, BBL./DAY
C = DISCHARGE COEFF
= 0.6 FOR H₂O
= 0.45 FOR 0.75 SP GR AVG. OIL
d = CHOKE DIA., IN.
P = DIFFERENTIAL PRESS., PS.I
OIL FLOW - BBLS. PER 24 HRS.
PRESSURE DROP - P.S.I.

Fig. 12: Oil flow, 1/32-in. to ¼-in. beans

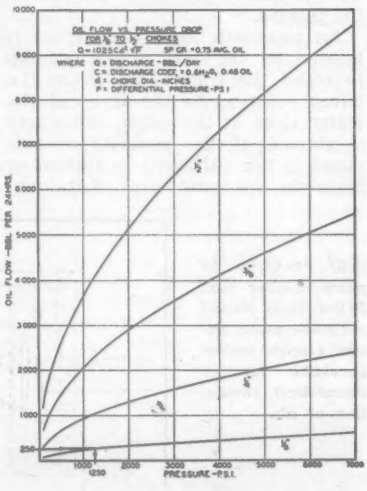

OIL FLOW VS. PRESSURE DROP
FOR ¼ TO ½ CHOKES
Q = 1025 Cd² √P SP GR = 0.75 AVG. OIL
WHERE Q = DISCHARGE - BBL./DAY
C = DISCHARGE COEF. = 0.6 H₂O, 0.45 OIL
d = CHOKE DIA. - INCHES
P = DIFFERENTIAL PRESSURE - P.S.I
OIL FLOW - BBL. PER 24 HRS.
PRESSURE - P.S.I.

Fig. 13: Oil flow, ⅛-in. to ½-in. beans

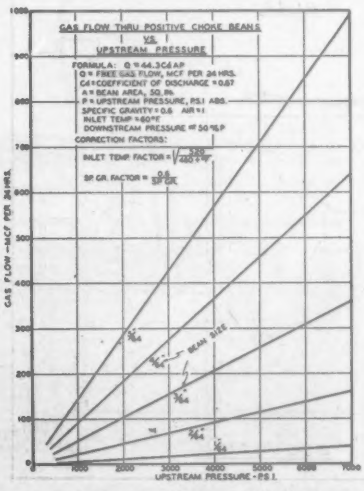

GAS FLOW THRU POSITIVE CHOKE BEANS
VS.
UPSTREAM PRESSURE
FORMULA: Q = 44.3 Cd AP
Q = FREE GAS FLOW, MCF PER 24 HRS.
Cd = COEFFICIENT OF DISCHARGE = 0.67
A = BEAN AREA, SQ. IN.
P = UPSTREAM PRESSURE, PS.I ABS.
SPECIFIC GRAVITY = 0.6 AIR = 1
INLET TEMP = 60°F
DOWNSTREAM PRESSURE = 50 %P
CORRECTION FACTORS:
INLET TEMP FACTOR = √(520/460+T)
SP GR FACTOR = 0.6/SP GR
BEAN SIZE
GAS FLOW - MCF PER 24 HRS.
UPSTREAM PRESSURE - P.S.I.

Fig. 14: Gas flow, 1/64-in. to 5/64-in. beans

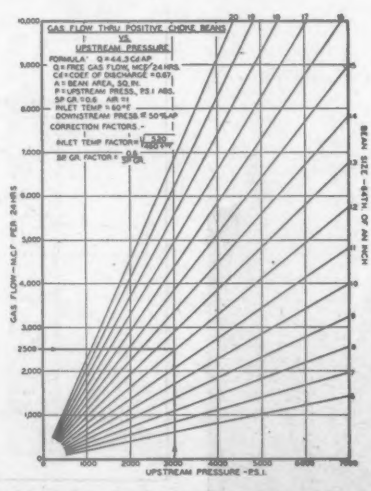

GAS FLOW THRU POSITIVE CHOKE BEANS
VS.
UPSTREAM PRESSURE
FORMULA: Q = 44.3 Cd AP
Q = FREE GAS FLOW, MCF/24 HRS.
Cd = COEF OF DISCHARGE = 0.67
A = BEAN AREA, SQ. IN.
P = UPSTREAM PRESS., PS.I ABS.
INLET TEMP = 60°F
DOWNSTREAM PRESS = 50 %P
CORRECTION FACTORS:-
INLET TEMP FACTOR = √(520/460+T)
SP GR FACTOR = 0.6/SP GR
BEAN SIZE - 64TH OF AN INCH
GAS FLOW - MCF PER 24 HRS.
UPSTREAM PRESSURE - P.S.I.

Fig. 15: Gas flow, 6/64-in. to 20/64-in. beans

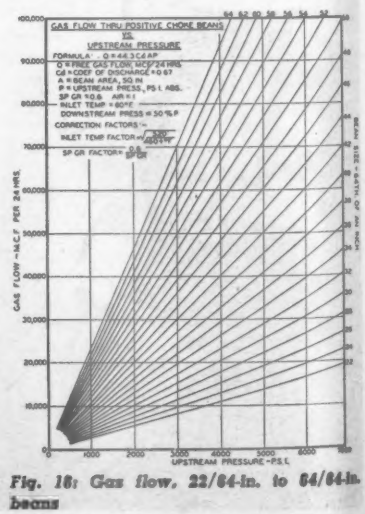

GAS FLOW THRU POSITIVE CHOKE BEANS
VS.
UPSTREAM PRESSURE
FORMULA: Q = 44.3 Cd AP
Q = FREE GAS FLOW, MCF/24 HRS.
Cd = COEF OF DISCHARGE = 0.67
A = BEAN AREA, SQ. IN.
P = UPSTREAM PRESS., PS.I ABS.
SP GR = 0.6 AIR = 1
INLET TEMP = 60°F
DOWNSTREAM PRESS = 50 %P
CORRECTION FACTORS:-
INLET TEMP FACTOR = √(520/460+T)
SP GR FACTOR = 0.6/SP GR
BEAN SIZE - 64TH OF AN INCH
GAS FLOW - MCF PER 24 HRS.
UPSTREAM PRESSURE - P.S.I.

Fig. 16: Gas flow, 22/64-in. to 64/64-in. beans

Oil Flow Through Beans

A typical set of curves which may be used for determining oil flow through chokes for average conditions is shown in Figs. 12 and 13. The following is an illustration of the use of the charts:

Find the orifice size which will pass 250 bbl. of oil per day with a pressure differential of 1,250 p.s.i. This differential is that between the downstream pressure (between the choke and the separator) and the primary or upstream pressure (tubing or well-head pressure as shown by a gage on the christmas tree). In following the chart (Fig. 12) for the stated conditions it will be noted that a horizontal line from the oil flow approximately intersects the vertical line from the pressure differential on the ⅛-in. flow-bean curve. The curves shown are sufficiently accurate for the average run of crudes along the Gulf Coast.

Gas Flow Through Beans

Gas flowing through an orifice is in accordance with factors in the formulas shown and set forth graphically in Figs. 14, 15 and 16. The flow through the bean is:

1. Directly proportional to the primary or upstream pressure (known also as tubing pressure or back pressure).

2. Directly proportional to the orifice or bean area.

3. Inversely proportional to the square root of the absolute inlet temperature.

4. Inversely proportional to the specific gravity of the gas at standard conditions.

5. Unaffected by the secondary or downstream pressure as long as it is below the critical throat pressure of the bean.

The critical throat pressure in the case of the curves illustrated and also for the usual flow bean is generally taken at 50 per cent of the secondary pressure.

With the chart shown in Fig. 15 as a basis, consider as an example a problem in which it is desired to flow 2,000,000 cu. ft. per day of field gas having a specific gravity of 0.70. In this problem the gas is entering the choke from the tubing flow lines at 3,000 p.s.i. and entering the flow lines to the separators at 1,400 p.s.i. The initial temperature of the gas entering the choke is 150° F. Find the required diameter of the flow bean.

Since the flow represented by these curves is based upon a gas having a specific gravity of 0.6 and a temperature of 60° F., the desired flow must be corrected with a factor of 0.792, calculated by means of the correction factors shown on the charts. The new value for the desired gas flow which should be used to determine the orifice bore will be:

$$\frac{2{,}000{,}000}{0.792} = 2{,}513{,}000 \text{ cu. ft./24 hours}$$

Starting on the ordinate for the curve with this quantity, at the intersection with the 3,000-p.s.i. pressure from the abscissa, it will be found that a 12/64-in. or 3/16-in. diameter orifice bore will produce the desired flow. Since the secondary pressure is less than 50 per cent of the primary pressure, the final flow is unaffected by the 1,400-p.s.i. downstream or outlet pressure.

Difficulties Involved in Choke Control Operation

Freezing.—Rapid expansion of gas due to sudden release of pressure at the casinghead, control valves, and more especially the production choke, often results in considerable cooling off the fluids and the accumulation of frost on the connections. The chilling effect on the oil may result in the separation of paraffin which is deposited within the well-head equipment. The paraffin may combine with sand to form an abrasive much like valve-grinding compound, and this combination often causes excessive wear in the flow beans of chokes. Also, the chilling effect on the metals in the various connections on the tree lowers their impact value, thereby reducing their factor of safety.

To offset this tendency, some operators locate the pressure-control equipment at a point where benefit may be received from the natural formation temperature. This, of course, may be quite readily accomplished by using one or more bottom-hole chokes or bottom-hole chokes and regulators, either alone or in a combination with a surface choke.

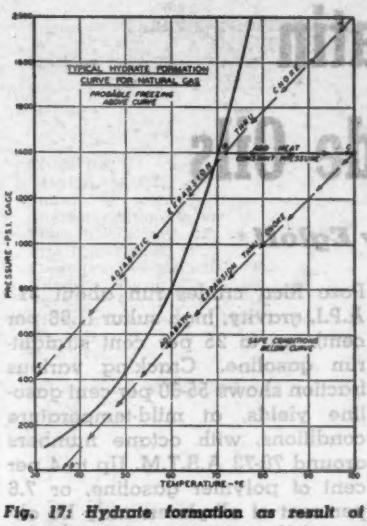


Fig. 17: Hydrate formation as result of expansion and temperature reduction

In still other instances, the oil and gas are passed through a heating device placed in the flow line between the choke and gas separator. The bottom-hole choke releases energy in moving the oil to the surface, and the temperature reduction is dissipated throughout the well tubing.

An additional safety measure against freezing of the connections in the case of an emergency shutin has been to equip the cellars with steam radiators and build a house over the christmas tree. This method of indirect heating was used in order to prevent the unequal expansion and contraction which would result from having steam coils in contact with the fittings. Heaters of similar type have been used in the Tomball field.

Freezing effect.—In large reductions of pressure, the resulting temperature drop may be sufficient to produce freezing of connate water vapors in the gas. This reaction is referred to as hydrate formation, and the collecting of these hydrates or ice crystals often causes stoppage of lines and equipment. In order to continuously produce such wells it is necessary to replenish a sufficient amount of the heat loss from the gas to prevent hydrate formation.

Some idea as to the temperature drop which would result in reducing gas is illustrated in Fig. 17. Gas allowed to expand freely releases work energy, which, if not absorbed in a surrounding mass in the form of heat energy, must be absorbed from the gas itself. Such expansion where no heat is added to the gas is expansion at constant entropy or adiabatic expansion. Adiabatic expansion, therefore, is accompanied by a fall in temperature of the gas which may be sufficient to produce

(Continued on page 249)

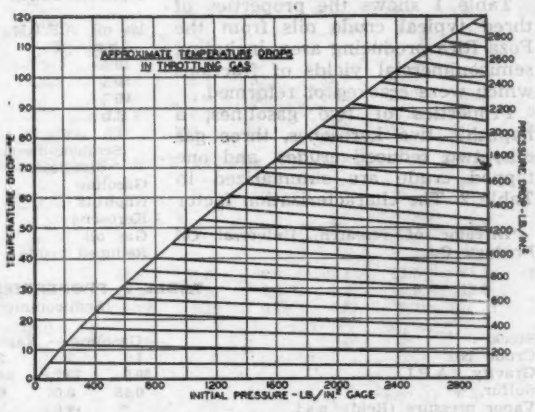


Fig. 18: Temperature drops for a natural gas when throttled

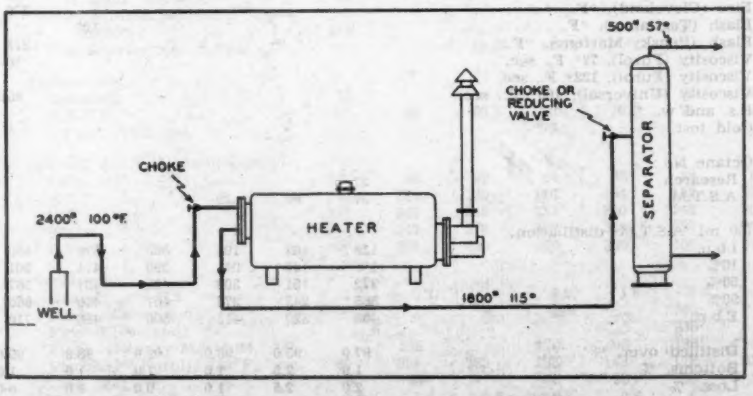


Fig. 19: Heater arrangement in connection with choke control

Cracking of Latin American Crude Oils

*by Gustav Egloff**

5. Poza Rica (Mexican)

Poza Rica crudes run about 31° A.P.I. gravity, high sulfur (1.66 per cent), up to 25 per cent straight-run gasoline. Cracking various fraction shows 55-60 per cent gasoline yields, at mild-temperature conditions, with octane numbers around 70-73 A.S.T.M. Up to 4 per cent of polymer gasoline, or 7.6 per cent of alkylates, may be obtained by polymerizing or alkylating the propylene and butenes in the cracked gases.

THE petroleum production from the Poza Rica district and the Isthmus fields of Mexico furnish the major portion of that country's oil at the present time. The Poza Rica crudes vary in A.P.I. gravity from 28° to 34°, most representative samples having a gravity of about 31°. The field was discovered in 1930, and by the end of 1934 Poza Rica was contributing about 15 per cent of the country's production.[1] In 1936, out of the total Mexican production of 40,309,000 bbl., Poza Rica contributed 13,417,000 bbl., or 33.8 per cent.[2] In 1939, the total production was 43,203,000 bbl., with Poza Rica furnishing 26,664,000 bbl., or 61.8 per cent of the output.[3] The figures for 1943 are 34,900,000 for all Mexico, and 20,500,000 bbl. for Poza Rica[4] (59 per cent).

Table 1 shows the properties of three typical crude oils from the Poza Rica producing area, including semicommercial yields of fractions which were cracked or reformed.

Properties of two gasolines, a naphtha, two kerosenes, three gas oils, two reduced crudes, and one topped crude are summarized in Table 2. The characterization factor of 12.5 exhibited by the 75.2-gravity light gasoline from crude No. 2 indicates a distinctly paraffinic stock which is also apparent in the naphtha fraction from this same crude oil. The paraffinic character of the gasolines and naphthas is further evidenced by the relatively low octane numbers of these stocks. The kerosene fractions from the two crude oils are practically identical, and their yields as shown in Table 1 are substantially the same.

The characteristics of five stocks subjected to cracking are indicated in Table 3. Stock No. 1 was the gas oil produced in the semicommercial distillation of crude oil No. 1. Cracking stock No. 2 was a proportional blend of the reduced crude, and the kerosene fraction obtained in the distillation of crude No. 2. Cracking stock No. 3 was a blend of 87.5 per cent by volume of topped crude produced in the semicommercial distillation of crude No. 3 after removal of the kerosene fraction, and 12.5 volume per cent of gas oil obtained in the full-scale commercial distilla-

*Director of research, Universal Oil Products Co.

TABLE 1—PROPERTIES OF POZA RICA CRUDE OILS

Crude No.—	1	2	3
Gravity, °A.P.I.	30.8	31.2	30.9
Viscosity, Universal at 100° F., sec.			61.3
Sulfur, %		1.66	1.78
B.s. and w., %		0.5	0.50
Cold test, °F.		10	5
Characterization factor		11.9	11.93
100 ml. A.S.T.M. distillation:			
I.b.p., °F.	137	138	140
10%	275	264	272
50%	641	638	652
90%	724	720	752
E.b.p.	724	720	760

Semicommercial distillation—	Vol., %	Gravity, °A.P.I.	Vol., %	Gravity, °A.P.I.	Vol., %	Gravity, °A.P.I.
Gasoline	25.0	59.9	6.5	75.2	23.3	62.9
Naphtha			19.2	54.5		
Kerosene	8.2	44.4	6.3	43.7	14.2	42.0
Gas oil	20.0	34.8	20.6	35.3		
Reduced crude	46.0	15.3	46.7	16.5	60.9	19.6

TABLE 2—PROPERTIES OF POZA RICA STOCKS
(Semicommercial distillation)

Stock	Gasoline		Naphtha	Kerosene		Gas oil			Reduced crude		Topped crude
Crude No.	1	2	2	1	2	1	2	3	1	2	3
Gravity, °A.P.I.	59.9	75.2	54.5	44.4	43.7	34.8	35.3	36.7	15.3	16.5	19.6
Sulfur, %	0.15	0.04	0.08	0.26	0.26	1.22	0.9	1.01	2.81	2.64	2.65
Vapor pressure (Reid), p.s.i.		12.0	1.2								
Characterization factor		12.5	12.0		11.9		11.8	11.79		11.6	11.71
Flash (Cleveland), °F.						255			465		
Fire (Cleveland), °F.						270			495		
Flash (Tagliabue), °F.					120						
Flash (Pensky-Martens), °F.						215	170	190	375		
Viscosity (Furol), 77° F., sec.						16					
Viscosity (Furol), 122° F., sec.									251	196	
Viscosity (Universal), 100° F., sec.						40	38.5	35.8			983
B.s. and w., %							0.1		0.3		0.5
Cold test, °F.						5	20	5	65		55
Octane No.:											
Research	37										
A.S.T.M.	37	60	29								
100 ml. A.S.T.M. distillation:											
I.b.p.	139	103	194	368	376	450	414	364	424	580	562
10%	186	125	241	390	414	501	502	420	629	682	613
50%	272	161	306	422	434	567	559	528	650	708	720
90%	365	243	376	467	460	666	650	610			
E.b.p.	408	320	415	506	488	710	705	663	711	728	
Distilled over, %	97.0	95.0	98.0	99.0	98.0	99.0	98.8	99.0	87.0	90.0	91.5
Bottoms, %	1.0	2.5	1.0	1.0	1.0	1.0	2.0	1.0			
Loss, %	2.0	2.5	1.0	0.0	1.0	0.0	0.0	0.0			
Coke, wt. %									12.9	10.0	8.5

tion of the same crude. The properties of the gas oil and topped crude in this blend are shown in Table 2. The wax distillate constituting cracking stock No. 4, and the pressed distillate constituting cracking stock No. 5 were both commercial products obtained in the refining of crude oils similar in characteristics to those shown in Table 1.

The five charging oils were cracked in a two-coil pilot plant to produce 400° F. end-point gasolines and residual fuel oils meeting A.S.T.M. No. 6 fuel specifications. The operating conditions and the yields of cracked gasoline, residuum, and gas are summarized in Table 4. Heavy oil transfer temperatures varying from 910° F. in the run on stock No. 4, to 940° F. in the two runs on stock No. 5 were used, and light oil transfer temperatures varying from 950° F. in the run on stock No. 2 to 1,000° F. in the second run on stock No. 3. The pressures employed ranged from 150 p.s.i. to 260 p.s.i. at the exit of the heavy-oil heating coils, and from 200 to 400 p.s.i. at the exit of the light oil heaters.

Properties of the untreated cracked gasolines, and the residua from the cracking runs are shown in Table 5.

All of the residua met No. 6 A.S.T.M. fuel-oil specifications in respect to viscosity, b.s. and w. content, and flash point, except the residuum from gas-oil stock No. 1, which had a viscosity of only 60 seconds Furol at 122° F., the minimum requirement being 100 seconds. Slightly deeper cracking will produce the required viscosity from this stock, along with further improvement in yield and quality of the gasoline.

The cracked gasolines were given a variety of light treatments to improve and stabilize their properties, the treating conditions and the properties of the treated products being outlined in Table 6. The cracked gasoline from gas-oil cracking stock No. 1 was treated with sulfuric acid and fuller's earth. The acid treatment was followed by neutralization with sodium hydroxide, rerunning with steam at a maximum still temperature of 350° F., and sweetening of the distillate with 3 per cent of 5° Be. sodium plumbite solution and sulfur. The clay treatment was conducted in liquid phase by pumping the gasoline through fuller's earth at 400° F. under a pressure of 250 p.s.i. Sweetening with 16° Be. sodium plumbite solution followed this treatment. Slight losses in octane number resulted from both types of treatment. The color and color stability were improved in each instance, and the inhibitor susceptibility was also improved as indicated by the increased induction period.

The cracked gasolines from the

TABLE 3—PROPERTIES OF POZA RICA CRACKING STOCKS

Cracking stock No.	1	2	3	4	5
	Gas oil	Blend of reduced crude and kerosene	Blend of 87.5% T.C. 12.5% G.O.	Wax distillate	Pressed Distillate
Crude No.	1	2	3	4	5
Gravity, °A.P.I.	34.8	18.9	21.1	25.6	27.0
Sulfur, %	1.22	2.45	2.36	2.05	1.98
Characterization factor	...	11.7	11.74	11.65	...
Flash (Cleveland), °F.	255	...	...	...	310
Fire (Cleveland), °F.	270	...	...	...	335
Flash (Pensky-Martens), °F.	215	216	220	130	270
Viscosity ,Furol), 77° F., sec.	16	...	...	...	15.5
Viscosity (Furol), 122° F., sec.	...	69	...	...	...
Viscosity (Universal), 100°F., sec.	40	...	426	88	74
B.s. and w., %	...	0.2	0.4	0.4	...
Cold test, °F.	5	30	45	80	15
100 ml. A.S.T.M. distillation:					
I.b.p., °F.	450	420	462	292	512
10%	501	534	568	554	577
50%	567	717	676	701	671
90%	666	...	...	760	760
E.b.p.	710	742	...	760	760
Distilled over, %	99.0	90.5	92.5	98.5	99.0
Bottoms, %	1.0	...	...	...	1.0
Loss, %	0.0	...	...	...	0.0
Coke, wt., %	...	9.5	7.6	1.2	...

TABLE 4—CRACKING OF POZA RICA STOCKS. OPERATING CONDITIONS AND YIELDS

Cracking stock No.	1	2	3	3	4	5	5
Run No.	..	..	1	2	..	1	2
Operating conditions:							
Temperatures, °F.:							
Heavy oil transfer	937	920	920	920	910	940	940
Light oil transfer	968	950	980	1,000	985	970	990
Pressures, p.s.i.:							
Heavy oil exit	260	200	200	250	200	200	150
Light oil exit	400	250	200	250	300	350	300
Relative charging rate	1.30	2.1	2.34	2.52	1.32	1.72	3.5
Yields, vol. per cent charge:							
Gasoline	57.1	39.3	39.2	39.7	55.9	57.9	51.9
Residuum	21.1	53.2	52.4	50.1	33.0	26.2	26.6
Gas and loss	21.8	7.5	8.4	10.2	11.1	15.9	21.5
Gas, cu. ft. per bbl. charge	836	394	389	466	575	640	882

TABLE 5—CRACKING OF POZA RICA STOCKS. PROPERTIES OF PRODUCTS

Cracking stock No.	1	2	3	3	4	5	5
Run No.	..	..	1	2	..	1	2
Untreated gasoline:							
Gravity, °A.P.I.	61.2	61.6	60.8	61.1	61.5	61.3	62.2
Vapor pressure (Reid), p.s.i.	10.3	10.9	8.5	9.4	10.9	15.0	9.3
Sulfur, %	0.13	0.19	0.19	0.19	0.21	0.22	...
Gum, mg./100 ml. (copper dish):							
Without inhibitor	8	...	...	...	...	15	...
With inhibitor No. 1 (0.025%)	5	...	...	...	...	9	...
Oxygen bomb stability induction period, min.:							
Without inhibitor	60	...	...	...	...	225	...
With inhibitor No. 1 (0.025%)	215	...	...	...	...	*250	...
Characterization factor	...	...	12.09	12.02	...	...	...
Octane No.:							
Research	78	...	...	...	...	78	86
A.S.T.M.	70	69	69.1	70.1	70	71	73
+3 ml. TEL/gal.	...	...	...	77.1	...	...	...
100 ml. A.S.T.M. distillation:							
I.b.p., °F.	101	98	92	94	93	88	94
10%	140	129	130	128	134	132	136
50%	234	240	240	234	240	242	206
90%	340	347	378	378	330	364	306
E.b.p.	400	397	400	396	336	400	378
Residuum:							
Gravity, °A.P.I.	1.7	8.3	7.9	6.9	1.8	—0.9	—0.7
Flash (Cleveland), °F.	...	...	...	...	...	300	...
Fire (Cleveland), °F.	...	...	...	...	...	335	...
Flash (Pensky-Martens), °F.	...	185	...	170	205	185	...
Viscosity (Furol), 122°F., sec.	60	291	183	238	143	172	213
Cold test, °F.	40	40	...	40	30	35	...
B.s. and w., %	0.3	1.4	0.3	0.3	0.4	0.7	0.8

*With 0.01% No. 1 inhibitor

TABLE 6—TREATMENT OF POZA RICA CRACKED GASOLINES—TREATING CONDITIONS AND PROPERTIES OF TREATED PRODUCTS

Cracking stock No.	1		2		3		4		5	
Run No.	..	..	..	..	*2				1	2
Treatment	Acid	Clay	Sodium plumbite	Sodium plumbite	Acid	Clay	Acid		Acid	
H_2SO_4, lb./bbl.	1	...	...	...	5	...	4		4	
Sodium plumbite, vol. %, 8° Be.	3	...	3	3	...	...	3		3	
Sodium plumbite, vol. %, 16° Be.	...	3	...	...	...	...	...		...	
Acid solution loss	0.8	0.0	...	...	1.6	...	0.9		1.5	
Polymerization loss	0.0	1.5	...	...	1.0	1.0	0.5		0.9	
Distillation loss	1.1	0.2	...	...	2.0	2.0	2.7		0.5	
Total loss	1.9	1.7	...	...	4.6	3.0	4.1		2.9	
Treated gasoline:										
Gravity, °A.P.I.	61.3	60.9	61.2	56.1	59.3	58.9	60.2		63.4	
Vapor pressure (Reid), p.s.i.	8.6	...	10.0	3.4	6.3	5.2	7.3		6.5	
Sulfur, %	0.09	0.09	0.19	0.19	0.11	0.20	0.11		0.09	
Color, Saybolt	30	30	14	...	22	27	26		30+	
Color stability	24	27	...	...	20	19	22		28	
Gum, mg./100 ml. (copper dish):										
Without inhibitor	2	5	277	149	33	94	17		3	
With inhibitor No. 1 (0.025%)	2	3	12	†5	9	6	8		2	
Oxygen bomb stability induction period, min.:										
Without inhibitor	110	90	80	50	80	90	135		45	
With inhibitor No. 1 (0.025%)	510	1,250	265	†240	575	300	670		710	
Octane No.:										
Research	76	76	...	...	...	...	76		...	
A.S.T.M.	...	...	68	69	67	68	69		72	
+3 ml. TEL/gal.	...	...	...	77	...	...	...		...	
100 ml. A.S.T.M. distillation:										
I.b.p.	103	116	98	139	114	114	100		104	
10%	141	152	127	181	158	162	144		138	
50%	228	226	240	252	248	244	240		210	
90%	328	326	351	354	324	322	372		285	
E.b.p.	380	386	392	400	362	362	384		350	

*Debutanized. †0.05%.

TABLE 7—GASES FROM CRACKING AVAILABLE POLYMER GASOLINES OR ALKYLATES

Cracking stock No.	3	3	4
Run No.	1	2	
Cu. ft. gas per bbl. charge	389	466	575
Composition,* % by volume:			
Hydrogen sulfide	1.4	1.4	0
Hydrogen	5.6	5.4	5.2
Methane	23.3	25.2	26.3
Ethylene	6.1	5.8	4.6
Ethane	19.6	19.9	20.8
Propylene	13.2	12.7	11.9
Propane	15.9	15.8	16.9
Isobutane	1.7	2.0	2.2
Isobutylene	2.6	2.5	1.5
n-Butylene-1	3.8	3.4	4.4
n-Butylene-2	1.1	0.9	
n-Butane	3.0	2.2	2.2
Pentylene, Isopentane, n-Pentane	1.3	2.2	4.0
C_6	1.4	0.6	
Liq., vol., % of charge:			
Propylene	3.16	3.64	4.21
Butylenes	2.12	2.36	2.46
Polymer gasoline, vol., % of charge:			
From propylene	1.91	2.22	2.52
From butylenes	1.47	1.64	1.70
Total	3.38	3.86	4.22
or Alkylates, vol., % of charge:			
From propylene	3.28	3.79	4.37
From butylenes	2.88	3.21	3.34
Total	6.16	7.00	7.61

*Co_2, CO, N_2, and O_2 free basis.

blended cracking stocks were merely sweetened with sodium plumbite and sulfur. The slight decrease in octane rating resulting from these two treatments was due to removal of light ends. The gasoline from stock No. 3 was debutanized before sweetening. The addition of 3 cc. of tetraethyl lead per gallon to this gasoline raised the A.S.T.M. octane number to the same extent as on the unsweetened gasoline.

Cracked gasoline from the wax distillate was treated with 93 per cent sulfuric acid at the rate of 5 lb. per barrel and rerun with steam at a 350° F. upper limit temperature, and was also refined by distilling it through fuller's earth in vapor phase at 400° F., and 45 p.s.i. Both of these treatments reduced the octane ratings from two to three points, although the inhibitor response as measured by decreased gum content and increase in induction period was improved.

The gasolines from both runs on the pressed distillate, stock No. 5, were treated with 4 lb. per barrel of 93 per cent sulfuric acid, rerun with steam, and sweetened with 3 per cent of 8° Be. sodium plumbite and sulfur. Small losses in octane rating occurred as a result of both treatments, although the gasoline from run No. 2 retained a value of 72.

Complete analyses were made on the gases produced in cracking the topped crude gas-oil blend and the wax distillate. The results of these analyses are shown in Table 7. Using factors based on commercial experience, calculations were made to indicate the yield of polymer gasolines producible by subjecting the gas mixtures to polymerization with solid phosphoric acid catalyst, and alternatively the yield of propylene and butylene alkylates obtainable by reacting of gaseous olefins with isobutane in the presence of such catalysts as sulfuric acid or hydrogen fluoride. Results of these calculations have been included in Table 7, and show that from 3.38 to 4.22 volume per cent polymer gasoline is producible from the cracking charges. If, instead of polymerizing the propylene and butylenes, they are used to alkylate isobutane, assuming a sufficient supply of this isoparaffin, alkylate yields from 6.16 to 7.61 volume per cent of the cracking charges will be normally obtained. The A.S.T.M. octane rating of the polymer gasoline will be of the order of 82, that of the propylene alkylate, 91, and of the butylene alkylate, 93.

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Unloading Retrograde Condensate From Dually Completed Wells

by E. H. Short, Jr.

LONG before the terms "two-phase reservoir," "gas distillate field," "cycling operations" and "retrograde condensation" became common, it was known that certain high-pressure gas wells producing fuel for drilling rigs would periodically load up with fluid. This accumulation was referred to as gasoline, kerosene, or high-grade crude. Eventually such wells ceased flowing and swabbing was necessary to restore the gas production.

While the oil terminology might have been different in the early days, such fluid accumulations were due to retrograde condensation. Anticipating the possibility of trouble from this source the La Gloria Operators Committee engineers took the necessary steps to prevent retrograde condensation trouble at the time each well was completed.

All Wells Dually Completed

All wells in the La Gloria pool, a total of 22, were dually completed. Also the wells were equipped with the piping arrangement and valves necessary to provide a simple, effective means of automatically unloading the accumulation of retrograde condensation.

Retrograde condensation takes place in not only the well, but also in the formation, when an appreciable drop in pressure occurs. Maintenance of reservoir pressure through cycling operations eliminates retrograde condensation in the formation itself; however, there is no way to prevent this type of condensation from taking place in the well bore. Therefore, if operations are to be carried on at the maximum efficiency, a means of unloading the distillate from the well must be provided at the time of completion.

Fig. 1 shows the La Gloria Operators Committee Unit No. 5. This compact surface installation is typi-

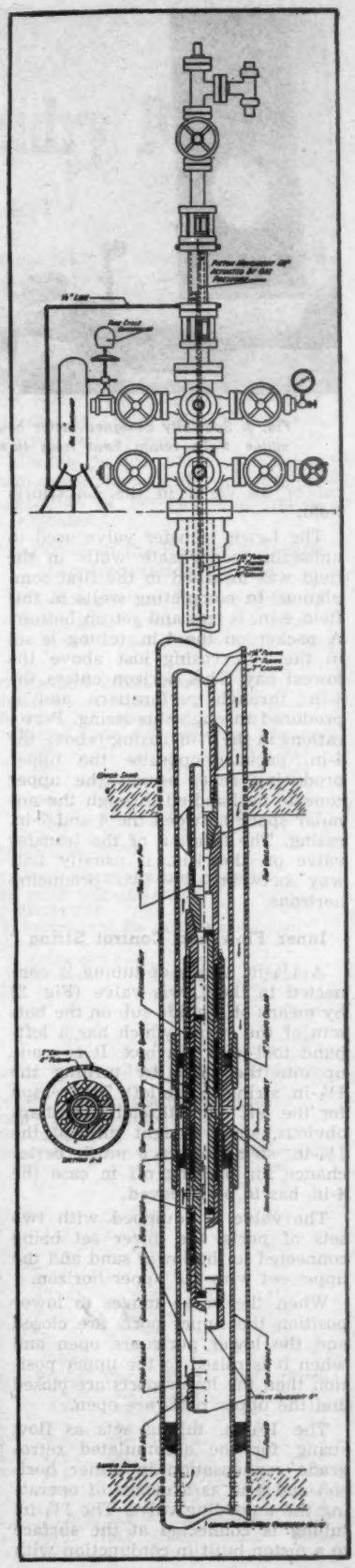

Fig. 1 (above): La Gloria Operators Committee Unit No. 5, typical of dually completed surface installations. Fig. 2 (right): Method of dual completion, using transfer valve for unloading retrograde condensate followed by committee

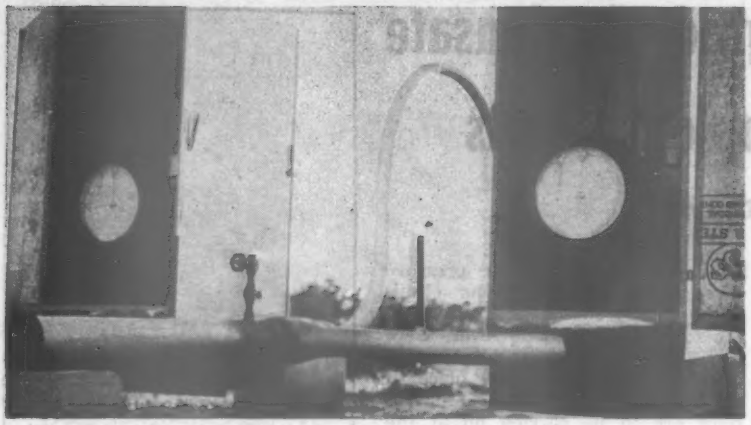

Fig. 3: Specially designed meter house used on La Gloria Operators Committee wells retain heat from flow line to prevent freezing of meters

cal of all wells in the La Gloria field.

The Lewis transfer valve used in unloading condensate wells in the field was installed in the first completion. In completing wells in this field 4-in. is run and set on bottom. A packer on the 4-in. tubing is set in the 7-in. casing just above the lowest pay. This horizon enters the 4-in. through perforations and is produced through this string. Perforations in the 7-in. casing (above the 4-in. packer) opposite the upper producing zone, permit the upper zone to be handled through the annular space between the 4 and 7-in. casing. The location of the transfer valve on the 4-in. is usually half way between the two producing horizons.

Inner Flow and Control String

A 1¼-in. string of tubing is connected to the Lewis valve (Fig. 2) by means of a guide sub on the bottom of the string which has a left-hand tool-joint pin box. It is made up into the valve by turning the 1¼-in. string to the left. The reason for the left hand thread is perhaps obvious, since a right turn of the 1¼-in. string offers a much better chance for backing off in case the 4-in. has to be removed.

The valve is equipped with two sets of ports, the lower set being connected to the lower sand and the upper set with the upper horizon.

When the valve moves to lower position the upper ports are closed and the lower ports are open and when it is raised to the upper position then the lower ports are closed and the upper ports are open.

The 1¼-in. tubing acts as flow string for the accumulated retrograde condensation in either horizon and also as a means of operating the unloading valve. The 1¼-in. tubing is connected at the surface to a piston built in conjunction with the christmas tree and the piston is operated by means of a time-cycle-control valve. A closeup of the surface installation at Unit 5 (Fig. 1) shows the oil container to the piston and also the time-cycle controller. The control valve (also shown in Fig. 2) when open allows high-pressure gas to enter the oil container, and this in turn forces oil through a ½-in. line connected beneath the piston, thereby raising the 1¼-in. string of tubing. The piston movement amounts to 40 in.

Mechanism of Control Cycle

When the time-cycle-control valve closes it allows gas pressure to bleed off slowly from the high-pressure oil container through a small orifice. Due to the weight of the 1¼-in. tubing this gradually forces the oil from the piston back into the oil container. The unloading valve may be set to operate at any time interval depending upon the accumulation of retrograde condensation. The liquid thus produced is measured through the meter run having the lowest pressure.

At the present time, a time cycle which permits the unloading of each formation once during a 24-hour period, is adequate.

Another step toward making the operation of the La Gloria Operators Committee wells as trouble free as possible is the use of a special meter house at each well. The walls and doors of these meter houses, which were designed by R. E. Houser, field superintendent, consist of two thicknesses of galvanized sheet iron with insulating wall board between. All joints are double bent so that when the door is closed the houses are practically air tight. Referring to Fig. 3 it will be noticed that a short section of the lines from the wells is completely enclosed by the house. Freezing of the meters is prevented by retention of the heat from the line.

Vapor recovery and fractionating plant in an East Coast refinery, designed and constructed by *Petroleum Engineering, Inc. Offices: Tulsa and Houston.*

BUTANE DEHYDROGENATION by the Houdry Process

by R. C. Lassiat and F. D. Parker†*

Employing catalysts of the chromia-alumina type (Cr_2O_3, Al_2O_3), a single-stage catalytic dehydrogenation process has been developed which may be used to yield large percentages of olefins, and diolefins such as butadiene, which in turn are intermediates for the manufacture of a huge number of chemicals from hydrocarbon bases. Butadiene formed per pass is 12.5 per cent, it is claimed, recycling olefins. Olefin production can be controlled closely, with up to 50 per cent conversions reported, for butane. Ethane and propane may be converted to olefins in 30 per cent for propylene, 16-20 per cent for ethylene. Many other applications of the process are possible, these authors indicate. This article was presented as a paper at the fall meeting of the California Natural Gasoline Association, at Los Angeles.

THE dehydrogenation of light hydrocarbons has attracted considerable attention in recent years as a means for making the large quantities of natural-gas constituents available for the manufacture of petroleum constituents, chemicals, and chemical intermediates At the beginning of the present war, major interest was focused on the production of butadiene—the principal constituent of buna-S synthetic rubber. Buna-S rubber production represents approximately 83 per cent of the total planned United States synthetic-rubber production.[1]

Previous Work

The literature contains numerous references to theoretical and laboratory studies of dehydrogenation yields, operating conditions, and catalysts.[2,3,4,5,6] It has been known for a number of years that normal butane can be dehydrogenated to butylene and butadiene at elevated temperatures in the presence of metallic oxide catalysts. One of the catalysts which is most attractive from the point of view of cost, activity, and ruggedness is chromic oxide supported on alumina.[1,2,3,5] While the literature indicates that attractive yields are obtainable with this catalyst, the details of catalyst manufacture, operating conditions, heat balances, process and mechanical features of the equipment in which the reaction can be carried out commercially had to be developed by technical groups active in the field.[4,5,7]

The basic chemistry of the dehydrogenation reaction is briefly illustrated below:

$$\underset{\text{(normal butane)}}{n\text{-}C_4H_{10}} \rightleftarrows \underset{\text{(normal butylene + hydrogen)}}{n\text{-}C_4H_8 + H_2}$$

$$\underset{\text{(normal butylene)}}{n\text{-}C_4H_8} \rightleftarrows \underset{\text{(butadiene + hydrogen)}}{n\text{-}C_4H_6 + H_2}$$

The above reactions occur to an appreciable extent only at temperatures above 900° F.

Table 1 presents equilibrium values for mol. fraction of n-butane, butene-1, and butadiene-1,3 as calculated from thermodynamic considerations by Gruse and Stevens.[6]

Table 2 lists equilibrium olefin concentrations as calculated from data of Gruse and Stevens[6], Kassel, and Pitzer. The work of the latter authors on this subject is summarized by Grosse and Ipatieff.[4] While the absolute values of equilibrium constants are at variance, the magnitude of per-pass conversions is indicated.

Description of the Houdry Adiabatic Dehydrogenation Process

Dehydrogenation is accomplished by passing the preheated hydrocarbon vapors under controlled condi-

TABLE 1—N-BUTANE DEHYDROGENATION EQUILIBRIUM*

Temperature			Equilibrium mol fraction							
			n-Butane		Butene-1		Butadiene-1,3		Hydrogen	
K	C	F	1 atm.	0.25 atm.	1 atm.	0.25 atm.	1 atm.	0.25 atm.	1 atm.	0.25 atm.
600	327	621	0.97	0.96	0.015	0.02	....	....	0.015	0.02
700	427	801	.72	.58	.14	.20	....	.01	.14	.21
800	527	981	.42	†.30	.27	.34	.01	.04	.30	.42
900	627	1,161	.20	.02	.29	.30	.07	.13	.44	.55
1,000	727	1,341	.01	.01	.22	.09	.18	.27	.59	.63

*"Rounded off" values from Gruse and Stevens. †Adjusted.

TABLE 2—COMPARISON OF CALCULATED EQUILIBRIUM OLEFIN CONCENTRATIONS IN BUTANE DEHYDROGENATION AT ATMOSPHERIC PRESSURE

Temperature			Equilibrium olefin concentration (mol %)		
°K.	°C.	°F.	Gruse and Stevens*	Kassel†‡	Pitzer†‡
700	427	801	14	8.3	11.4
773	500	932	25	20.6	24.5
873	600	1,112	34	40.3	41.9
1,000	727	1,341	40	48.7	48.7

*Includes butene and butadiene. †Butene only. ‡Reported by Grosse and Ipatieff.

TABLE 3—COMPARISON OF LABORATORY, SEMICOMMERCIAL AND COMMERCIAL UNITS; HOUDRY SINGLE-STAGE BUTADIENE PROCESS

Unit—	Pilot plant		Semicommercial		Commercial	
Catalyst capacity, cu. ft.	0.35		11.7		1,060	
Number cases	1		1		6	
Operating conditions:						
Cat. temp., on-stream, °F. ave.	1,060		1,124		1,100	
Cat. temp., off-stream, °F. ave.	....		1,083		....	
Cat. temp., °F. ave.	....		1,103		1,070	
Pressure, inches Hg. abs.	5.0		4.9		4.9	
Time on-stream, mins.	10.0		7		10	
Charge temperature, °F.	....		1,085		1,075	
Regeneration air temp., °F.	....		1,140		1,075	
Charge rate, V/V/hr.	1.9		2.8		2.7	
Regeneration air rate, CMF/liter	0.5		1.8		2.2	
Yields, % wt.:	Chg.	Prod.	Chg.	Prod.	Chg.	Prod.
C_3 and lighter	....	1.6	4.6	7.8	2.2	3.7
Isobutane	2.5	3.7	3.1	1.6	0.9	1.9
Isobutene	....	3.5	1.5	2.3	2.1	2.5
n-Butene	26.8	36.8	28.9	26.9	23.1	23.1
n-Butane	70.5	42.9	62.7	46.3	67.0	53.3
Butadiene	0.2	10.1	....	11.3	3.8	12.7
C_5 plus	....	0.4	....	0.8	0.9	1.7
Coke	....	1.0	....	2.5	....	1.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Houdry Laboratories, Catalytic Development Corp. †Bechtel-McCone Corp.

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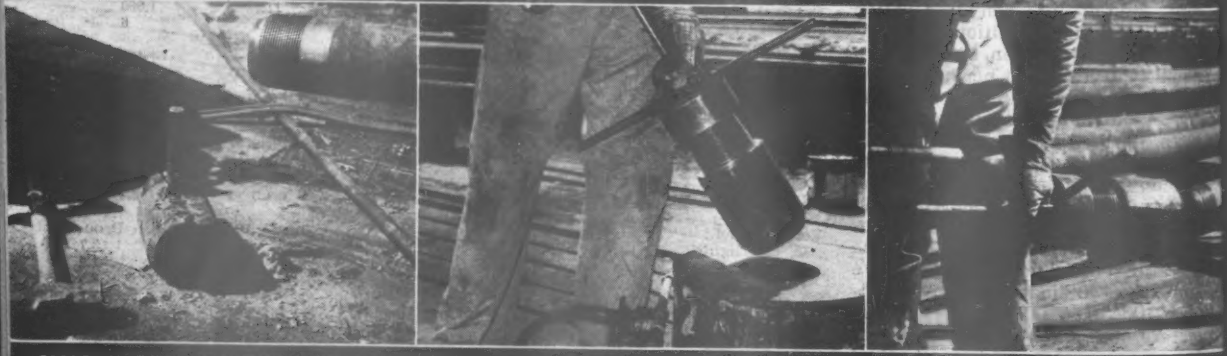

SIMPLY CUT OFF THE OLD TOOL JOINT... HEAT THE NEW TOOL JOINT... AND SCREW IT ON, BY HAN

tions of space velocity, temperature, and pressure over catalysts of the chromic oxide (Cr_2O_3) alumina type. A study of their catalytic behavior as related to their physical and chemical characteristics has resulted in the preparation of materials of controlled and highly selective activity suitable for various dehydrogenation charging stocks described in this paper.

During the reaction period a large amount of heat is absorbed due to the heat of reaction which is of the order of 1,000 B.t.u. per pound of butene produced from butane, 2,000 B.t.u. per pound of butadiene produced from butane. In addition to products of dehydrogenation, fixed gas is liberated and coke is deposited on the catalyst. This coke has to be burned off periodically in order to restore the initial catalyst activity.

The characteristic feature of the Houdry dehydrogenation process is that the operating conditions are so chosen that the heat used for the reaction during the onstream period is substantially the same as the heat developed by the combustion of the coke deposit. Furthermore, the heat capacity of the catalyst bed is controlled by mixing with the active catalyst in the form of pellets, a catalytically inert material. Several sources of such inert material are available, but secrecy orders do not permit disclosure of further details at this time. The inert material acts as a heat-storage medium absorbing during the regeneration cycle the heat liberated by the combustion of the coke deposit, with a consequent increase in temperature of the bed, and releasing that heat to the reacting hydrocarbons during the dehydrogenation period, with decreasing temperature.

The preferred condition is that the heat of reaction be slightly greater than the heat of combustion. The heat efficiency and the desired operating temperature are controlled by the adjustment of reactant and air temperatures, and by the use in the regeneration cycle of an amount of air substantially greater than the combustion requirements. The latter equalizes differences in temperature in a large-size bed due to heat losses in parts adjacent to the wall, imperfect flow distribution of fluids throughout the bed, minor inequalities in catalyst activities and heat capacities, and the like. The air used being near atmospheric pressure, the cost of pumping is nominal and the heat can be recovered in waste-heat boilers.

The inert material posseses a very large surface and the heat exchange between this material, the catalyst pellets, and the reactants takes place with very small temperature differences.

The on-stream periods are kept very short, namely, between 7 and 15 minutes. By this means the temperature variation during the cycle is small, usually within 50° F. covering the optimum range of temperature necessary to insure high conversions; also the total coke deposit on the catalyst is limited to a low value, insuring high catalyst activity throughout the cycle.

The advantages derived from the use of this scheme are as follows:

1. Expensive special-alloy heat-exchange equipment within the reactor is eliminated and the reactor construction is cheap.

2. Reactants are introduced at substantially reaction temperature, eliminating problems of prethermal cracking.

3. The temperatures are controlled within the desired range of reaction. No excessive temperatures are encountered during the regeneration period, thus protecting catalyst life.

4. Regeneration can be accomplished by the use of fresh air, with no limitation of oxygen concentration, and there is no problem of recirculating hot gases.

5. High conversion per pass and high product concentration are feasible.

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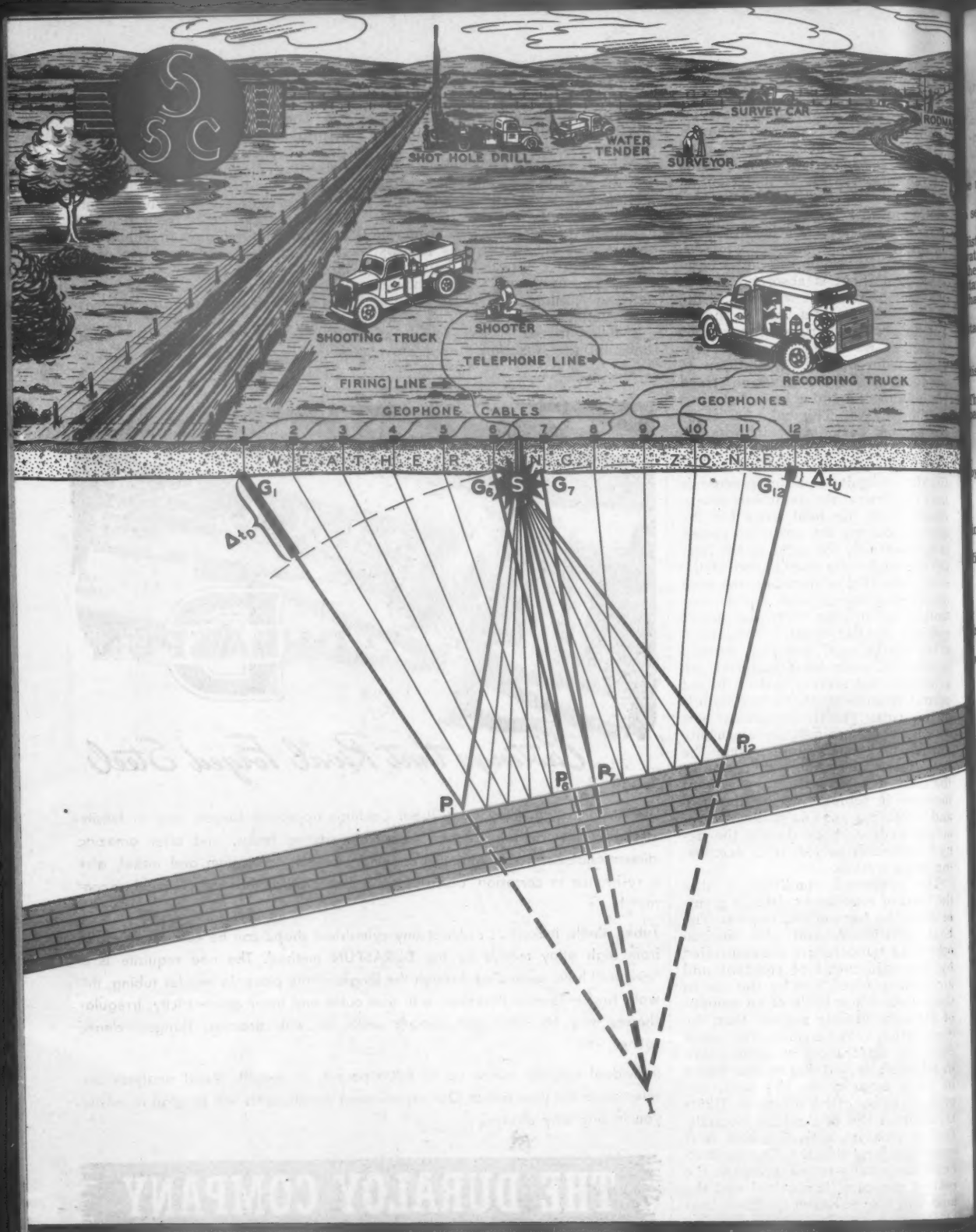

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Reflection Technique for LOW ANGLE DIPS

In some areas of low angle dips, there often is little continuity in the reflecting surfaces, and structures cannot be reliably mapped either by correlation or by the normal continuous profiling method.

For such areas, computation techniques were devised so that the individual dips for all reflections appearing on a seismogram could be computed. In practice, this may be done by measuring *stepout* Δt of each reflection.

The fundamental principle involved in this method of dip calculation is that, under similar conditions of velocity distribution, the *stepout* or the difference in reflection times (after correcting for variations in weathering and elevation) between any two geophones is a function of the dip of the reflector. Thus, for a constant spread distance, the difference in reflection time (Δt) between two geophones will remain constant for a horizontal bed. This constant may be called the normal *stepout* or Δt_N. It follows that for profiles shot down dip the *stepout* will be greater than Δt_N, and for profiles shot up dip, the stepout will be less than Δt_N.

The diagram on the opposite page, utilizing the image point demonstration, should serve to clarify the above statements.

The diagram was constructed as follows:

The image point I, is located on a perpendicular from the shotpoint to the reflecting surface, and is the same distance below the reflector as the shotpoint is above it.

Lines are drawn connecting the image point with the geophones (below the weathering) G_1, G_6, G_7, and G_{12}. These lines intersect the reflecting surface at the corresponding points of reflection, P_1, P_6, P_7, and P_{12}. Thus the paths of the reflecting rays are SP_1G_1, SP_6G_6, etc.

Referring to the diagram,

$$SP_1 = P_1I;\ SP_6 = P_6I;\ SP_7 = P_7I;\ \text{etc.}$$

The up dip *stepout*, Δt_U, is given by the difference between G_7P_7I and $G_{12}P_{12}I$. The down dip *stepout*, Δt_D, is given by the difference between G_6P_6I and G_1P_1I.

Assuming the reflecting surface P_1P_{12} to be a plane,

$$\Delta t_D = \Delta t_N + \Delta ta_1 \qquad (1)$$

$$\Delta t_U = \Delta t_N - \Delta ta_2 \qquad (2)$$

in which Δta_1 and Δta_2 are those portions of each *stepout* due only to dip.

For low angle dips, Δta_1, and Δta_2 may be considered equal. Thus, solving equations (1) and (2) simultaneously, first by adding and second, by subtracting.

$$\frac{\Delta t_D + \Delta t_U}{2} = \Delta t_N \qquad (3)$$

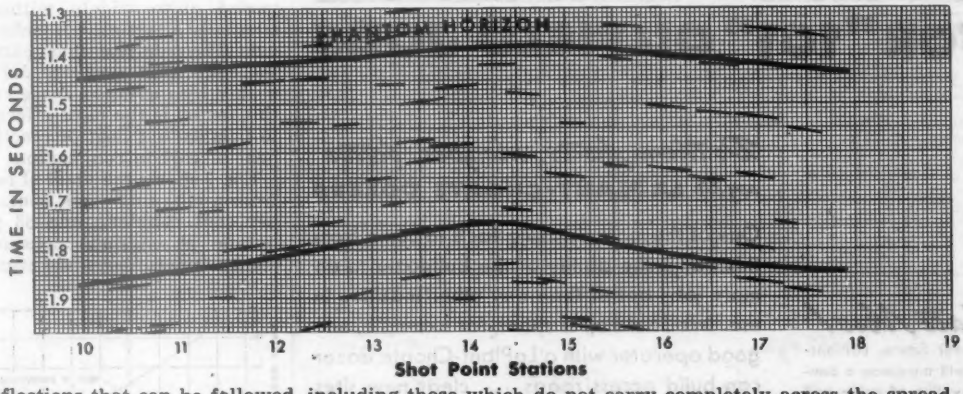
$$\Delta t_D - \Delta t_U = \Delta ta_1 + \Delta ta_2 = \Delta ta \qquad (4)$$

in which Δta represents the dip, measured in time, along the subsurface P_1P_{12}.

Omitting some of the more technical aspects of the problem, these dip computations may be graphically represented in time or in feet, and plotted as dip components on a cross section.

TYPICAL LOW DIP CROSS SECTION

(Taken from Actual Traverse)



All reflections that can be followed, including those which do not carry completely across the spread, are timed, and their dip components are computed and plotted on the cross sections.

After the dips are plotted, phantom horizons may be drawn conforming to the average of those dips that fall within an arbitrary depth range. The latter will usually depend upon the results, and upon the structural peculiarities of the area.

Traverses are normally run in polygons, so that the closure of the phantoms may be determined. If the phantom fails to close, the misclosure may be due to accumulated errors, or possibly, to faulting. In order to determine the cause of the misclosure, after rechecking the computations, additional traverses my be run to reduce the size of the polygons. Thus, the misclosure may be isolated for a more specific examination by detailed shooting.

Continuous profiling has contributed considerably to the success of low angle dip shooting, since it furnishes 100 per cent sub-surface coverage. It is much more effective than spot dip shooting, which leaves gaps in the cross section where important structural features might exist.

continuous commercial operation have proved the practicability of this unique development.

Effect of Variables in Dehydrogenation of Butane and Butane-Butene Cuts

Temperature. — Dehydrogenation equilibria referred to previously indicate that high temperatures are required for conversions of commercial interest. These equilibria are such that monoolefins can be produced economically at substantially atmospheric pressure and temperatures of the order of 1,050°-1,100° F. For the production of diolefins, however, not only high temperatures but also low partial pressures are necessary. These can be attained by either diluting the reactants with some inert gas or vapor or opeating at low absolute pressure. Considerations of cost usually preclude the use of gases. Steam has been found to be detrimental to the reaction, as well as to catalyst life. Operating at reduced pressures as low as 2½ lb. absolute has been found practical for the production of diolefins and the engineering problems connected with this type of operation have been readily solved.

Fig. 1 shows the effect of temperature at various space rates on the dehydrogenation of butane. These data were obtained during the study of butadiene production and were, therefore, obtained at reduced pressure. Of interest is the rapid increase of yield with temperature, the decrease in selectivity, and the rapid increase in coke formation above 1,100° F.

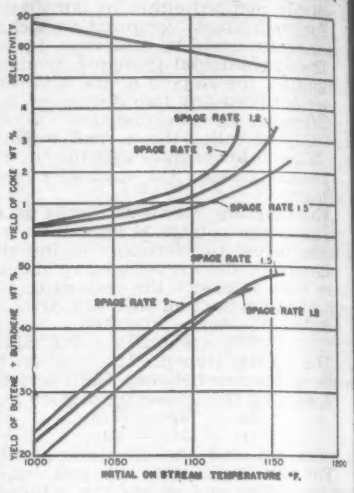


Fig. 1: Dehydrogenation of n-butane, showing effect of temperature in adiabatic unit operating at 7-in. Mg. absolute pressure

Space rate.—Space rate can be varied quite widely without substantially affecting the yield of products. The side reactions, particularly the coke formation, are cut considerably by increased space rates and this factor is the most effective way to balance out heat of reaction with heat of carbon combustion.

Fig. 2 shows the yield of butadiene from a charging stock containing 35 per cent n-butene and 65 per cent butane at constant pressure, constant temperature, and varying space

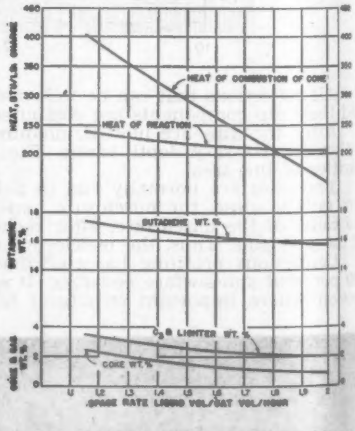


Fig. 2: Dehydrogenation of butane-butene in isothermal unit: charge 65 per cent n-butene, 35 per cent n-butane, temperature 1,100°, showing effect of rate at pressure of 5 in. Hg. absolute

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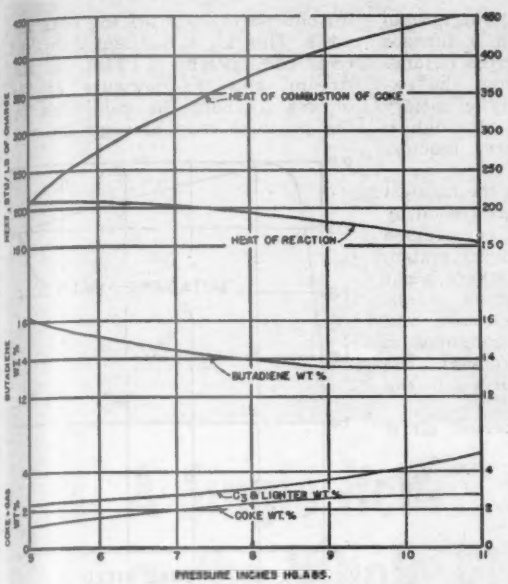


Fig. 3: Dehydrogenation of butane-butene in isothermal unit: charge 65 per cent n-butene, 35 per cent n-butane, temperature 1,100°, showing effect of pressure at space rate of 1.8 vol./vol./hour

rate. The upper curves show the calculated heat of reaction and heat of combustion, respectively. The point at which the curves cross is the point of operation at "adiabatic condition." These data were obtained in a laboratory isothermal unit.

Pressure.— With the range of pressures necessary to effect the desired reaction an adjustment in pressure also provides means of controlling the coke deposit in relation to the heat of reaction.

Fig. 3 shows the effect of varying pressure at constant temperature and space rate on same charging stock as above, i.e., 35 per cent n-butene and 65 per cent n-butane. Again it can be seen that the curves showing heat of reaction and heat of combusion cross at the operating point for the chosen space rate and temperature.

Feed composition. — Fig. 4 shows the relationship between butene in original fresh feed, butene in composite feed to reactor, butene in recycle stock, and butadiene in reactor product. It shows the

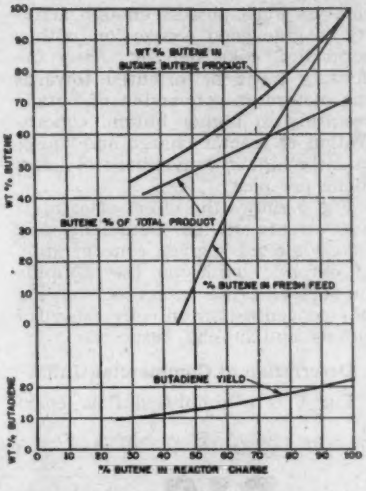

WT % BUTENE IN BUTANE BUTENE PRODUCT
BUTENE % OF TOTAL PRODUCT
% BUTENE IN FRESH FEED
BUTADIENE YIELD
WT % BUTENE
WT % BUTADIENE
% BUTENE IN REACTOR CHARGE

Fig. 4: Dehydrogenation of n-butane-n-butene in adiabatic unit, temperature 1,100°, space rate 1, 5 in. Hg. absolute pressure

yields of products from once-through operation (lower scale) and the yield and product distribution in recycling operations. For example, starting with n-butane (0 per cent butene in fresh feed), the reactor charge builds up to approximately 44 per cent butene and the yield of butadiene per pass is 12.5 per cent.

Catalyst activity.—From the above

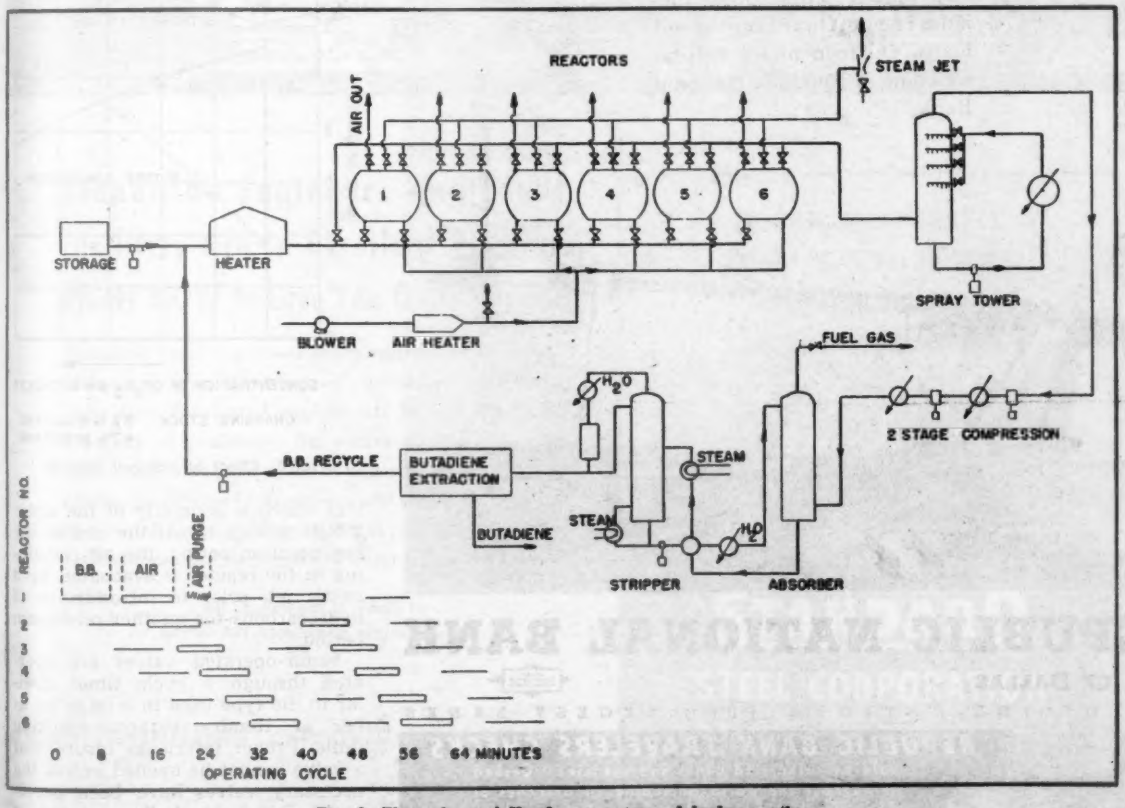


Fig. 5: Flow chart of Houdry one-stage dehydrogenation

considerations, it is evident that the catalyst must possess enough activity to give good conversion with a controlled coke deposit. Also, the activity must be oriented towards the maximum conversion of butane resulting in higher butene concentration in reactor charge and subsequently higher conversions of butadiene per pass.

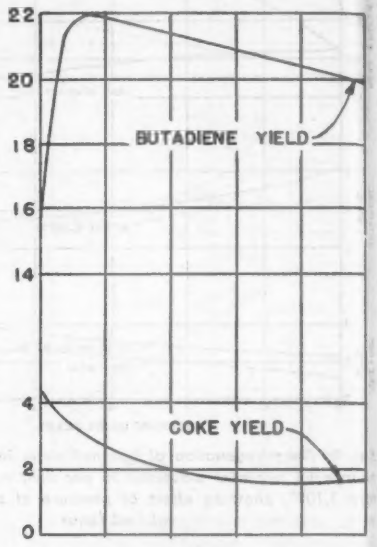
Fig. 5 shows the effect of catalyst heat treatment on butadiene and coke yield for a given concentration of chromic oxide on the alumina support and the effect of varying this concentration on conversions of butane and butene, respectively.

Description of Commercial Units

Fig. 6 is a simplified flow chart of the single-stage unit. The normal butane is preheated in a furnace along with the unconverted butane-butene cut recycled from the extraction unit. The catalytic battery comprises six reactors, although it could be built with three reactors of same total capacity.

After passing through the catalyst bed, the hydrocarbons are cooled by direct spraying with oil, compressed and sent to a vapor-recovery system of conventional design where a cut of butadiene-butene-butane is obtained. Butadiene is extracted and purified by solvent or a combination distillation-solvent extraction, the remaining B-B cut returned to the process as recycle stock.

After the on-stream period, air is introduced to burn off the coke deposit. This air is preheated by direct combustion of fuel in the stream, and the pressure at the blower discharge is controlled by the pressure drop through the system which is generally of the order 2-3 lb. per sq. in. At the end of the regeneration period, the air remaining in the reactor is evacuated by a steam jet, prior to introduction of hydrocarbons for another on-stream period.



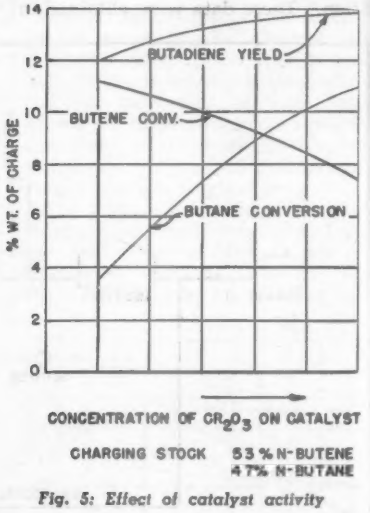
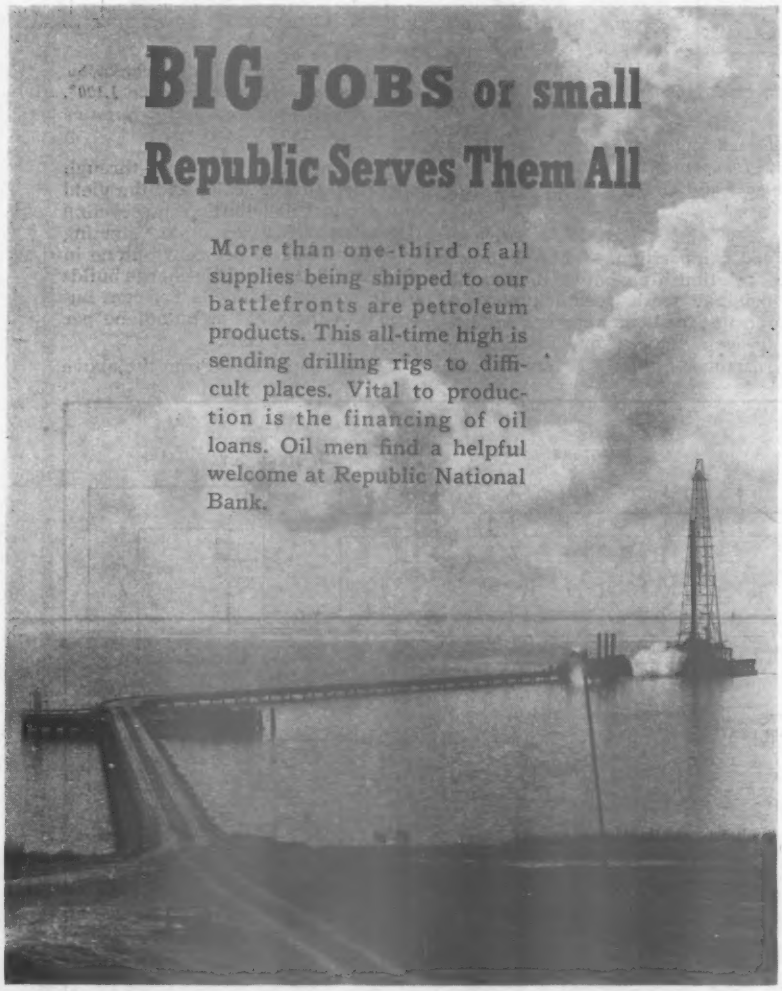


Fig. 5: Effect of catalyst activity

Motor-operated valves are operated through a cycle timer similar to the type used in a large number of Houdry catalytic-cracking units. Proper interlocks insure that a valve cannot be opened unless the necessary valves have been previously closed, precluding mixing of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various streams. As a further precaution against mixing of streams through valve leakage, inert gas is automatically admitted in the bonnets and lantern rings provided in the packings when valves are closed. The flow of reactants and air is continuous; two reactors of the battery receiving hydrocarbons while two are receiving air, and the last two being under valve change or purging operation. Heat can be recovered from the cooling oil by heat exchange with the furnace feed and from the air stream in waste-heat boilers.

A very satisfactory two-stage operation has also been developed. Secrecy restrictions imposed by government agencies preclude discussion of the details of operation at the present time.

Commercial operation of the Houdry adiabatic catalytic dehydrogenation process is carried on by Sun Oil Co. at its Toledo refinery and Standard Oil Co. of California at its El Segundo refinery. Both of these facilities were built by Defense Plant Corp., and are operated by the respective oil companies for the account of Rubber Reserve Co. Butadiene production from the Toledo plant is utilized in the production of GR-S rubber at the copolymerization plants of Firestone and Goodyear at Akron; butadiene from the El Segundo installation is utilized at the U. S. Rubber and Goodyear plants at Torrance, Calif. One of these plants operates in the single-stage cycle as described above. The other plant is equipped to operate either single or two-stage.

Table 3 gives a comparison of typical pilot plant, semicommercial plant, and commercial plant operating conditions and yields. Commercial results are in general agreement with the correlation of Fig. 4, with certain deviations as regards butene concentration in the reactor charge, although butadiene yields per pass predicted in the correlation are obtained.

Application of the Process to Production of Monoolefins

For the production of butenes from the corresponding normal and isobutane, the reaction is conducted at atmospheric or slight positive pressures and the space rate adjusted to balance the coke formation with the necessary heat of reaction. Laboratory and semicommercial operations have indicated the possibility of obtaining up to 50 per cent conversion with selectivities of the order of 70 to 75 per cent. The plant flow sheet is substantially the same as the one-stage unit. Line sizes and compression recovery facilities are smaller than with vacuum operation.

If it is desired to produce both butadiene and butenes, the process can be operated under reduced pressure. In this case it is more practical to balance the heat requirements by supplementing the normal coke production. This can be accomplished by passing on the catalyst a nominal amount of an extraneous material heavier in boiling range than the charge, after the dehydrogenation period.

Propane and ethane can be dehydrogenated to their corresponding monoolefins. The equilibrium concentrations in the same temperature region are lower than for the dehydrogenation of butane. Consequently, the yields per pass are correspondingly lower, of the order of 30 per cent for propene and 16-20 per cent for ethylene. The selectivities are high and the coke formation low at atmospheric pressure, and means of supplementing the coke formation as described above are used.

In order to obtain ultimate yields, it is necessary to provide means for selectively removing the ethylene or propylene, as the case may be, from the reactor effluent after quenching and recovery by compression and/or absorption. As is well known, the ethylene can be removed by sulfuric acid and synthetic ethyl alcohol produced by hydrolysis. Propylene can be similarly removed to form isopropyl alcohol on

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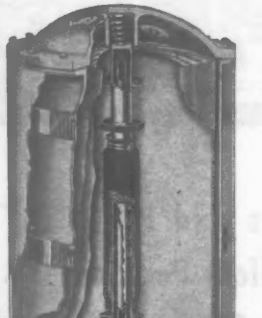

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subsequent hydrolysis. It is therefore seen that a whole field of potential chemical industries is opened up by catalytic dehydrogenation of the relatively inert paraffin constituents of natural gas and gasoline to olefins or diolefins, which can be reacted in a number of ways to produce a large number of products. Fig. 7, from Bureau of Mines Information Circular 7108, diagrammatically shows a few of the intermediates and chemicals which can be produced from paraffinic hydrocarbons through the initial step of dehydrogenation.

Other Applications of the Process

Among the other products which have received attention in laboratory scale experimentation are:

Isoprene from dehydrogenation of isopentane.

Styrene from ethyl benzene.

Methyl styrene from isopropyl benzene.

These reactions, not being limited by the low equilibrium concentration of the lower olefins, take place readily in the range of 1,000°-1,050° F., and yields per pass of the order of 45 per cent styrene and 60-65 per cent methyl styrene are obtained.

The principle of storing regeneration heat in an inert high-heat-capacity medium in the catalyst bed has still another interesting application in the Houdry adiabatic catalytic cracking process for the conversion of heavy petroleum fractions to gasoline.

Conclusion

In conclusion, it may be stated that the Houdry adiabatic catalytic dehydrogenation process has made available to the petroleum refining, petrochemical and natural-gasoline industries a means of converting paraffins from ethane through pentane to olefins and di-olefins. Other dehydrogenation reactions of commercial interest can be handled by the process. Commercial operation of the Houdry adiabatic dehydrogenation process for the production of butadiene proves the feasibility of the process. Large potentialities for production of chemicals from petroleum are opened up, and it is therefore expected that the process will find application in postwar dehydrogenation projects.

Acknowledgment

The authors wish to express their appreciation of helpful suggestions made during early pilot-plant and semiplant studies by the technicians of Socony-Vacuum Oil Co., Inc.; Standard Oil Co. of California; Standard Oil Co. of Indiana, and Sun Oil Co.

Permission of Sun Oil Co. to use commercial-plant data is acknowledged.

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11. "Synthetic Rubber—Progress Report No. 6," Office of Rubber Director.

O. D. Donnell, president of The Ohio Oil Co., has received the Silver Antelope award of Boy Scouts of America in recognition of distinguished service to the boyhood of America.

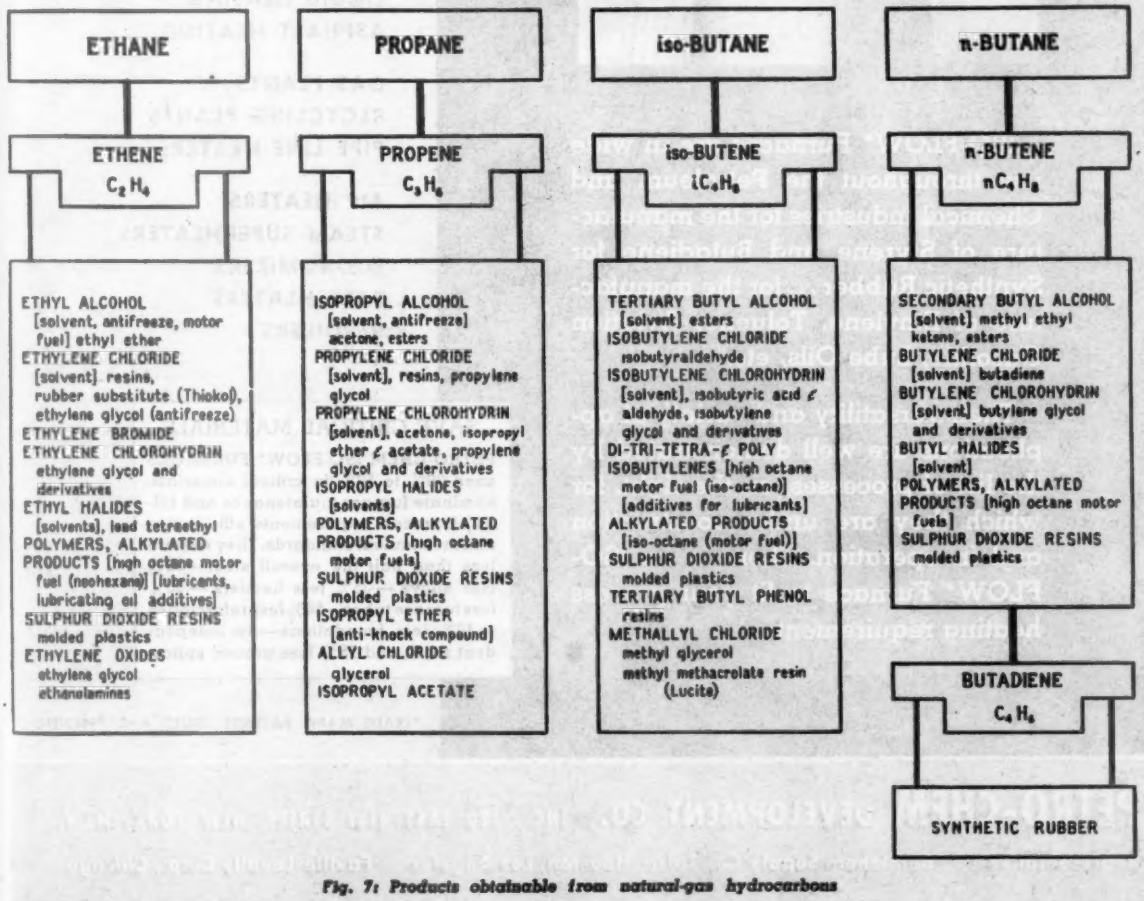
ETHANE
ETHENE
C_2H_4
ETHYL ALCOHOL [solvent, antifreeze, motor fuel] ethyl ether
ETHYLENE CHLORIDE [solvent] resins, rubber substitute (Thiokol), ethylene glycol (antifreeze)
ETHYLENE BROMIDE
ETHYLENE CHLOROHYDRIN ethylene glycol and derivatives
ETHYL HALIDES [solvents], lead tetraethyl
POLYMERS, ALKYLATED PRODUCTS [high octane motor fuel (neohexane)] [lubricants, lubricating oil additives]
SULPHUR DIOXIDE RESINS molded plastics
ETHYLENE OXIDES ethylene glycol ethanolamines
PROPANE
PROPENE
C_3H_6
ISOPROPYL ALCOHOL [solvent, antifreeze] acetone, esters
PROPYLENE CHLORIDE [solvent], resins, propylene glycol
PROPYLENE CHLOROHYDRIN [solvent], acetone, isopropyl ether & acetate, propylene glycol and derivatives
ISOPROPYL HALIDES [solvents]
POLYMERS, ALKYLATED PRODUCTS [high octane motor fuels]
SULPHUR DIOXIDE RESINS molded plastics
ISOPROPYL ETHER [anti-knock compound]
ALLYL CHLORIDE glycerol
ISOPROPYL ACETATE
iso-BUTANE
iso-BUTENE
iC_4H_8
TERTIARY BUTYL ALCOHOL [solvent] esters
ISOBUTYLENE CHLORIDE isobutyraldehyde
ISOBUTYLENE CHLOROHYDRIN [solvent], isobutyric acid & aldehyde, isobutylene glycol and derivatives
DI-TRI-TETRA-& POLY ISOBUTYLENES [high octane motor fuel (iso-octane)] [additives for lubricants]
ALKYLATED PRODUCTS [iso-octane (motor fuel)]
SULPHUR DIOXIDE RESINS molded plastics
TERTIARY BUTYL PHENOL resins
METHALLYL CHLORIDE methyl glycerol methyl methacrolate resin (Lucite)
n-BUTANE
n-BUTENE
nC_4H_8
SECONDARY BUTYL ALCOHOL [solvent] methyl ethyl ketone, esters
BUTYLENE CHLORIDE [solvent] butadiene
BUTYLENE CHLOROHYDRIN [solvent] butylene glycol and derivatives
BUTYL HALIDES [solvent]
POLYMERS, ALKYLATED PRODUCTS [high octane motor fuels]
SULPHUR DIOXIDE RESINS molded plastics
BUTADIENE
C_4H_6
SYNTHETIC RUBBER

Fig. 7: Products obtainable from natural-gas hydrocarbons

VERSATILITY

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VACUUM DISTILLATION
ATMOSPHERIC RERUNNING
VACUUM RERUNNING

GAS PYROLYSIS
THERMAL REFORMING
THERMAL CRACKING
CATALYTIC REFORMING
CATALYTIC CRACKING
VISCOSITY BREAKING

HYDROGENATION
POLYMERIZATION
ALKYLATION

SOLVENT TREATING
SOLVENT DEWAXING
SOLVENT CONCENTRATION
FILTROL FRACTIONATION
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QUESTIONS ON TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Bottle Gas Grading System

A bottle gas is described to us as B-95-10. What is the meaning of the number?—G. F. C.

Liquefied petroleum gases are sometimes described by a grading system fostered by the California Natural Gasoline Association and the number stated above appears to be such a number.

Bulletin No. TS-392 of the C.N.G.A., Los Angeles, entitled "Tentative Standard Methods of Test for Liquefied Petroleum Gases, 1939," which describes this grading, has recently been reprinted.

STANDARD GRADES

C.N.G.A. grade	Maximum range of vapor pressure, lb. gage at 100° F.	Range of allowable specific gravities 60° F./60° F.	Composition
A	80	.585-.555	Predominantly butanes
B	100	.560-.545	Butane-propane mixtures, largely butanes
C	125	.550-.535	Butane-propane mixtures, about equal proportions
D	150	.540-.525	Butane-propane mixtures, rich in propane
E	175	.530-.510	Propane-butane mixtures, largely propane
F	200	.520-.504	Predominantly propane

The seller should describe the gas by giving the letter of the grade, the vapor pressure, and the temperature (°F.) at which 90 per cent of the gas is evaporated. Thus, the B-95-10 description stated in the question refers to a Grade B gas that has a vapor pressure of 95 lb. (Ga.) and has a 90 per cent evaporated temperature of 10° F. If the letter M is used before the last number, as B-95-M10, it means that the 90 per cent evaporation temperature is minus 10° F.

Benzol Gasoline

I hear that benzol and other aromatic hydrocarbons are very good gasolines. Are the so-called benzol gasolines superior and why not mix benzol with all our gasoline?—M.G. R.

Aromatic hydrocarbons, such as benzene, toluene, xylenes, etc., all improve the combustion characteristics of most gasolines, but there is certainly not enough of these materials available for the purpose and the cost is high. During 1937 the production of such hydrocarbons by the operation of coke ovens in the United States was somewhat as follows:

	Bbl. per day
Benzol-crude and refined	1,400
Motor benzol	6,240
Toluol-crude and refined	1,360
Solvent naphtha	370
Xylol	300
Other light oil products	530
	10,200

When this total is compared with the 1,423,000 bbl. per day of gasoline produced during this same time it is apparent that the aromatic content of gasoline could be raised by only about 0.72 per cent even if all of the coke-oven aromatics were put into the gasoline, and the use of motor benzol would increase the aromatic content by only 0.44 per cent if all of it were put into gasoline.

Many gasolines, particularly those from aromatic crude oils or made by catalytic cracking or reforming processes, contain 10 to 40 per cent of aromatics and hence they are the equal to or are greatly superior to most of the benzol gasolines being marketed.

Dew Point of Natural Gas

What is the relationship between the dew point of a gas and its water content?—H. P.

The dew point of gases that contain only one liquefiable constituent, such as air which contains only moisture, can be computed with ease. The question indicates that the dew point (low temperature that causes condensation of moisture) has been measured. If so, the moisture content can be computed by looking up the vapor pressure of water at that temperature (steam tables or other source) and using the following formula:

$$y = \frac{100p}{B}$$

in which:

y = percentage by gas volume of water vapor in the wet gas
p = vapor pressure of water
B = barometric pressure in same units as p.

To state this equation on a pound basis it is necessary to decide the kind of gas that is involved so that its molecular weight can be known. If the gas is air and the condensable constituent is water:

$$W = \frac{100 \times 18p}{(B-p)\,28.9 + 18p}$$

in which W is the weight percentage of water in the wet air. Other gases or condensable constituents can be handled by using suitable molecular weights rather than 18 and 28.9.

A more convenient basis for most purposes is "pounds of water per pound of dry air" and this is the definition of humidity:

$$H = \frac{18p}{28.9\,(B-p)}$$

The humidity of a gas that is at a temperature above its dew point is the most common case, but a discussion of this situation is beyond the scope of this page, and in fact is such common knowledge that the reader is referred to Chemical Engineer's Handbook, by Perry; Elements of Chemical Engineering by Badger and McCabe, or Principles of Chemical Engineering by Walker and others, all McGraw-Hill books and all of which have good discussions of the Grosvenor humidity chart. A discussion of this situation also appears on page 53 of the July 10, 1941, issue of the Questions on Technology page of the Journal.

If perchance the question pertains to gases such as natural gas which contain several condensable constituents (hydrocarbons) as well as water vapor, the situation becomes too complicated for discussion here.

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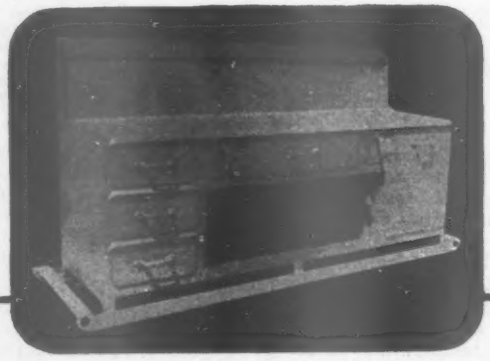

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Engineering Fundamentals

No. 160

A FEATURE OF THE OIL AND GAS JOURNAL

Pore Systems in Reservoir Rocks

OOLITIC limestones are rocks made up of minute spherical grains of calcium carbonate 0.1 to 0.5 mm. in size and more or less firmly cemented together with calcium carbonate cement (Fig. 1). In this illustration the porosity varies from 13 per cent to 19 per cent and the permeability from 3 md. to 80 md. In many places the oolitic layers are not uniform in thickness or extent but occur in the oil reservoirs in lentils of oolite grading laterally into crystalline, more or less nonporous limestone. The porosity and permeability and hence the capacity and performance of the reservoir depend, to a large extent, on the size of the oolites, the amount of cementation between oolite granules, and the thickness and uniformity of the oolitic mass.

The flow characteristics of oolitic limestones are much the same as those for quartz sands except that the cementation in most places is greater and hence the permeability and porosity are generally lower, especially if the oolite grains are mixed with small calcium carbonate granules as in some of the oil horizons in the Glen Rose formation. Then, too, production rates and well capacities generally vary more in oolitic limestone than in quartz sand reservoirs, since oolitic layers have a tendency to change into nonoolitic layers and also are likely to have less uniform cementation than quartz sand. In the terms of the oil operator, oolitic lime formations in some wells are tight and in other wells loose.

Reservoirs in which porosity is due to voids, crevices, and cracks in limestone have very irregular porosity and permeability due to variation in pore-space characteristics. Some voids in the rock are due to spaces between calcium carbonate crystals, others to fossil cavities of various sizes, still others are solution channels and enlargements of natural cavities, and in many places there are numerous tiny cracks and joint lines which connect cavities and allow both vertical and lateral migration between cavities. In perhaps a majority of places, the voids act as tiny tanks which drain through tiny cracks. These serve as gathering lines into larger but fewer solution channels formed along the joints, which in turn may be thought of as pipe lines which convey the oil to a well, or even longer distances to an oil reservoir.

The porosity of these limestone reservoirs depend upon the size and number of connected voids. The permeability depends upon the size of the largest channels through which the oil is drained to the well. In many places the porosity may be relatively low and the permeability exceedingly high, so the flush production is drained out very quickly, and the unrestricted production-decline curve is steep. Also, since nearly 90 per cent of the flow of oil to a well feeds through only the few large channels, permeability measurements of small chunks of the reservoir rocks are of no value in calculating the productivity of the rock as a whole. Early recognition of the rock types of oil reservoirs by production engineers is important and most helpful in evaluating new oil discoveries and in planning drilling operations and well-spacing programs.

Reservoirs in which porosity is due largely to cracks and open joints have quite variable porosity and permeability depending upon the number of cracks and joints and the width of the openings. In many places, the openings are only capillary in dimensions and the production of a well is low until the rock around the hole is shattered with explosives to widen cracks and open up more passageways into the well. Often the vertical cracks and crevices are larger than the horizontally directed ones, consequently, the vertical lines of migration are drained first and bottom water brought into a well long before the horizontal drainage of oil is complete. Another characteristic of such reservoirs is a remarkably delicate adjustment of pressure and flow characteristics through long distances. For example, if one well starts producing water, wells miles away also may show water, and pressure decline in one well may be reflected in wells miles away. Porosity and permeability measurements of small chunks of the reservoir rocks of such wells are of little value, since the chunks are usually broken out between cracks. Hence, engineers in recognizing this type of reservoir and evaluating its production characteristics need to depend largely upon their knowledge of rock types and the performances of the wells already completed.

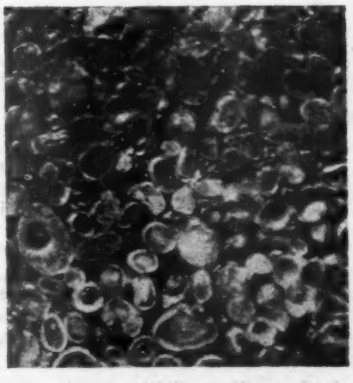

Fig. 1: Photograph of oolitic lime formation, showing shape of oolites. The specimen is in cross section so that the oolite grains are in the shape of ellipses. When uncut, they are ellipsoidal in shape and fairly uniform in size. In some places they are in the shape of spheres. (Magnified approximately 20 times)

Comparison of Reservoirs

Data on porosity, permeability, and production decline curves collected from a large number of reservoirs indicate that, other conditions being comparable, the unconsolidated quartz sands are most porous and most permeable, produce the most oil per unit of sand volume, and have oil wells of more nearly comparable production characteristics. The oolitic limestone reservoirs in character are like quartz sands but more erratic due to lenticularity and variation in cementation and extent of recrystallization. Limestone and dolomite reservoirs containing cracks, fissures and channels generally are the most erratic producers of all. Each well in a reservoir of this type may be quite different from its neighbors in productivity. The rock penetrated may show large differences in porosity, permeability, and thickness of oil saturation.

Series prepared by F. B. Plummer, professor, petroleum engineering school, University of Texas

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The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

Vent Lines—Vapor Handling

IN the design of vent lines, vent valves, and vapor connections to fixed-roof storage tanks it is necessary to estimate the amount of vapor that breathes in or out. The amount of vapor-air mixture moved depends upon:

1. Vapor volume—an empty tank provides the biggest volume.
2. Pumping rate.
3. Temperature changes — most rapid changes in temperature of the vapor space are about 40° F. per hour during heating and about 50° F. per hour during cooling.
4. Vapor pressure of liquid—materials having a Reid vapor pressure in excess of 14 lb. per sq. in. are stored in pressure tanks (see Refinery Notebook No. 7).
5. Boiling—store such liquids in pressure tanks.
6. Explosions and fires—handle by explosion hatches, weak roof-to-shell joint, or liquid-sealed vents.

Maximum vapor movement occurs during:

1. Pumping a 14 R.v.p. material into an empty tank while the tank temperature is rising rapidly.
2. Pumping a 14 R.v.p. material out of a nearly empty tank while the temperature is falling rapidly.

The whole problem of venting has been analyzed by Louis Bosa in "The Calculation of Heating Requirements for Low-Pressure Oil Storage Tanks," (The Oil and Gas Journal, Nov. 18, 1938, p. 196). For maximum venting conditions his method shows that the vapor to be vented per hour is 1-1.35 cu. ft. for each barrel of tank capacity to which is added 10 cu. ft. for each gallon per minute that the pumps can handle. Stated as an approximation which is conservative for nearly all situations:

$$\text{Cu. ft./hr.} = C + 10P$$

in which C is capacity of tank in barrels, and P is capacity of pumps in gallons per minute.

Vent valves and lines.—Regular tanks can seldom hold a pressure or vacuum exceeding 2 oz. (1¾ in. water) per square inch and it is common to use an upper limit of ¾ oz. (1⅓ in. water). Balloon systems often operate at 1⅝-in. water and balloon roofs operate at 2½ to 6½ in. water. Manufacturers of vent valves (breathers) have capacity charts for their equipment and these should be consulted in the installation of vent valves. The same applies to flame arrestors or combination flame arrestor and breather units except that they tend to become clogged on all but finished stocks and hence may handle only 80 per cent of the manufacturers' capacity.

Ordinarily the weight of a column of vapor is negligible but when dealing with pressures of only 1 in. of water per sq. in., it cannot be neglected. Table 1 indicates the pressure in inches of water caused by a column of vapor 100 ft. in height. All of the vapors are heavier than air, except methane, and hence they cause a pressure whereas methane causes a lift.

The pressure losses (inches of water) caused by vapor flow through lines which lead vapors out of a plant or into balloon systems can be computed from the figure shown on this page. Its use will be illustrated in the example given below. The constriction caused by elbows, tees, etc., expressed as diameters of straight pipe are about the same for this service as for other fluid systems.

Example.—A 25,000-bbl. tank with pumps for 3,000 g.p.m. requires venting of 25,000 plus 10 times 3,000, or 55,000 cu. ft. per hour. For a 14-lb. gasoline the vapor will be nearly pure gasoline (S = 2.5) and the pressure drop through 120 ft. (including elbows) of 10-in. pipe would be 1.2 × 1.3 = 1.56 in. water. The 1.3 was obtained by connecting 2.5 on the specific gravity scale to 55,000 on the capacity scale, and by a line through 10 on the pipe size scale and the point on the reference line. If the tank connection is 40 ft. above the discharge point (to air) the column of vapor will cause a pressure of 0.4 times 2.13 or 0.85 in. water and the pressure on the tank will be 1.56 less 0.85 or 0.71 in. of water per sq. in.

TABLE 1

	Mol. wt.	Sp. gr. referred to air	Pressure caused by 100-ft. head, in. water
Methane	16	0.55	—0.65
Ethane	30	1.04	0.06
Propane	44	1.52	0.78
Butane	58	2.00	1.5
Gaso. vapors	50-100	...	2.2-3.6
Air	28.9	1.00	0
80% mix*	..	1.36	0.53
60% mix*	..	1.72	1.06
40% mix*	..	2.08	1.60
20% mix*	..	2.44	2.13
Gaso. vapors	81	2.80	2.67

*Mix of air with 81 mol. wt. gasoline vapor.

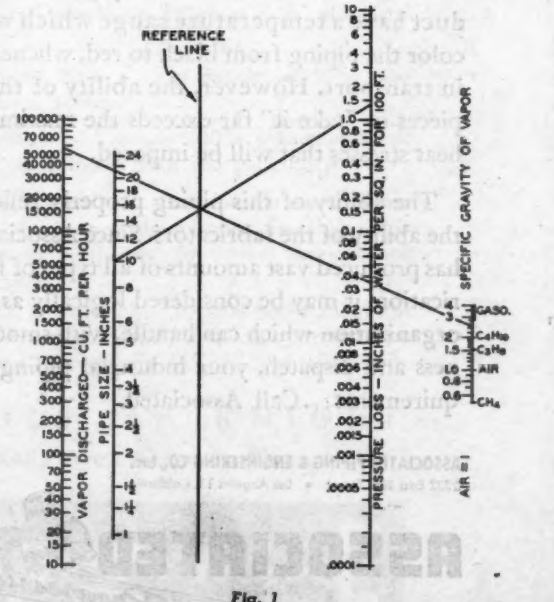

Fig. 1

No. 18 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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The elements this fabricated pipe is to conduct have a temperature range which will color the piping from black to red, whenever in transport. However, the ability of these pieces to "take it" far exceeds the maximum heat stresses that will be imposed.

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Choke Control of Gulf Coast Wells

(Continued from page 217)

hydrate formation or freezing. The hydrate formation curve shown indicates the hydrate expectancy temperature for a natural gas. Dotted in is an example of gas expanding from 2,000 p.s.i. and 100° F. If the gas were allowed to expand freely (Curve A to E), it would cross the hydrate formation curve, resulting in freezing. To prevent freezing, the gas must not be allowed to expand adiabatically; heat must be added. Curve B to C represents the addition of sufficient heat to raise the temperature back to 100° F. which is sufficient to allow the gas to expand adiabatically from 1,400 p.s.i. to atmospheric pressure without freezing, (C to D). Actually if the gas were choked directly into the heater from 2,000 p.s.i., the expansion would not have been adiabatic at any time within the heater, but would have been along some curve between A and D and between the two adiabatic curves shown.

Approximate Temperature Drop in

The curve shown in Fig. 18 gives the approximate temperature drop for a natural gas when its pressure is allowed to drop from a higher to a lower pressure. The values given as stated are approximate and will vary with hydrate content and the gas itself, but may be applied to the general run of conditions for average interpretations.

Consider, for example, a gas entering the flow bean at 3,000 p.s.i. and leaving at 1,400 p.s.i., making a 1,600-lb. drop. On the 3,000-p.s.i. pressure line and 1,600-p.s.i. pressure-drop curve, it will be found that the temperature drop of the gas will be 65° F.

Curves of the type shown in Fig. 18 should be based upon actual conditions; but where complete and accurate data for each individual well are not available, average values may be taken as a basis for calculation.

Heaters

A typical hookup from well to the separator using a heater is shown in Fig. 19. It should be noted that the primary surface control is moved from the christmas tree to a point at the heater. The secondary surface control, usually a pressure control regulator, is between the heater and separator. A surface choke should be maintained at the christmas tree for some reduction and safety.

The heater may be of the modern automatic type and consist of a hot water bath tank, a high-pressure gas coil bundle, a pressure-retaining hatch and an automatic water-level-maintenance mechanism.

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"Change the RUBBERS and Save the Piston

REFINING

Gulf Coast Gasoline Stocks Continue Rising Trend

HOUSTON. — Inventories of all grades of gasoline at plants of Gulf Coast Refiners Association members continued to rise during the second half of October, reaching a total of 1,589,825 bbl., an increase of 35,059 bbl. over that recorded October 15. A year ago total gasoline stocks were 1,429,501 bbl. Two years ago the stockpile was 2,289,362 bbl., 699,537 more than the current figure.

Automotive gasoline stocks considered alone were 524,580 bbl. on November 1, showing an increase since October 15 of 111,441 bbl. but reflecting continuing low inventory of this product. A year ago automotive gasoline stocks were 619,269 bbl. The present total represents only 36 per cent of the 1,418,619 bbl. of automotive gasoline reported on November 1, 1942. Refiners say this indicates the need for further improvement in gasoline stocks to restore them to proper working levels.

Total stocks of all products in the plants of the GCRA group were reported at 4,226,521 bbl. November 1, an increase of 52,146 during the last half of the month. A year ago total products stocks were 3,370,340 bbl. Stocks of all products at this time 2 years ago totaled 5,988,064 bbl., considered about normal for that time of the year.

Crude-oil throughput of 125,592 bbl. a day maintained the high levels reported during the past several months. Crude runs were 89.7 per cent of rated operating capacity and represent an increase of 19,180 bbl. daily in comparison with operations at 83 per cent of capacity a year ago when the group processed 106,412 bbl. a day. Two years ago crude runs were 86,435 bbl. a day.

Edmonton Syndicate Takes Over Lloydminster Plant

LLOYDMINSTER, Sask. — The Lloydminster refinery, built in 1939 but relatively inactive since then, has been taken over by an Edmonton syndicate including A. A. Voice, George Richardson, J. H. Purvis and C. C. Johnston. An electrical dehydrating plant with a capacity of 1,200 bbl. daily is being shipped from Los Angeles to handle the Lloydminster crude which now is shipped to the Vermilion refinery. A spur line is being laid from the refinery to the Canadian National Railways track.

Control of Solvents to Be Continued Indefinitely

WASHINGTON.—War Production Board announced last week that controls covering both Class A and Class B solvents as defined in Order M-150 (aromatic solvents) would be continued indefinitely. Class A solvents as defined in the order are generally known as xylene range aromatic solvents, and Class B as toluene range aromatic solvents.

During recent weeks the board considered the possible revocation of controls covering Class A solvents, but military requirements for xylol for the aviation gasoline program make such action impossible now, oficials said. Class B solvents also continue in short supply because of toluene requirements for aviation gasoline and high explosives.

Refiners Fight Proposed Freight-Rate Increase

WASHINGTON.—A strong protest against the proposed reinstatement by the railroads of the 6 per cent increase in freight rates, now suspended, has been filed with Interstate Commerce Commission by Pe-

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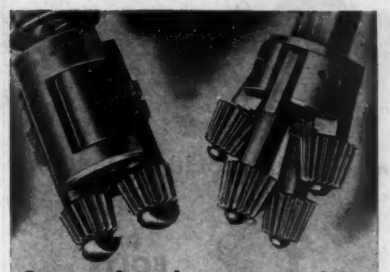
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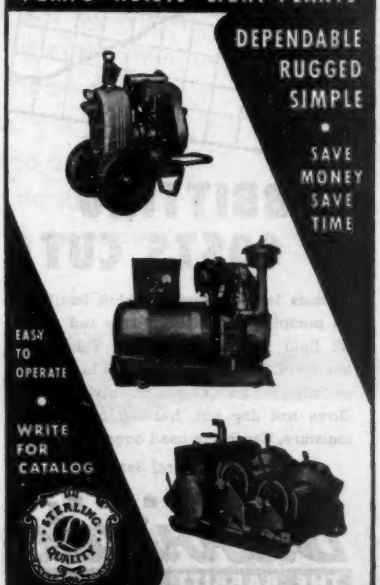
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troleum Shippers Association, made up of Oklahoma, Texas, and Arkansas refiners who ship by rail.

The association's statement, presented to the commission by Douglas Orme, president, asserts that the increase is not necessary at this time and that the proposed action is based on expected conditions which cannot be foretold with accuracy.

The statement cites increased refining costs and predicts that it will be necessary for refiners to appear again before the commission for further exploration of the trainload or multiple car rate considered by the commission in 1941.

Noting the 3 per cent federal transportation tax on rail movement of petroleum imposed December 1, 1942, the statement says reinstatement of the suspended 6 per cent increase would mean that the commission has increased the federal tax, adding:

"Under present OPA regulations, that means that both the increased freight rates and increased transportation tax must be absorbed by the industry and cannot be passed on to the consumer in the form of higher prices.

"Ability of the independent branch of the petroleum industry to absorb these increased costs now and continue to make the vital contribution to the war effort and assume its normal place in the reconversion economy affording full employment to returning veterans and others released from war work, pay its taxes and maintain its purchasing power, is just as questionable as are these same problems to both now and for the duration, as well as in the postwar period.

The statement emphasizes the oil industry's war record and cites three important developments in converting to a war economy:

1. Production, distribution and consumption of petroleum for essential civilian and military use has reached unheard-of volumes.

2. The independent refiner is primarily a rail shipper. There has been a rapid expansion of transportation facilities, such as construction of many thousand miles of pipe lines, construction of many additional barges and tow boats for inland waterway transportation, seagoing tankers and an expanded use of the motor truck for short-haul transportation.

3. An increase in the independent refiner's cost of doing business in higher wages, materials and loss of efficiency through manpower and material problems, despite the fact the price of his products has been frozen.

The application of the railroads for permission to increase rates is attributed to apprehension over possible future traffic decline on the end of the European war; but it showed that refiners too were apprehensive of the future and uncertain over prices, costs and taxes.

Ceiling-Price Regulation Undergoes Revision

WASHINGTON.—Thirteen changes have been made in the regulation setting ceiling prices for petroleum products at all levels of distribution except at retail establishments, Office of Price Administration announces. Seven, of general applicability to the industry, deal mainly with definitions and procedure for determining ceilings. The six other changes apply only to specific areas. They add new spelled-out ceiling prices or amend and clarify actions in connection with previous spell-outs or formula pricing. The action became effective November 15.

No Increase in Fuel-Oil Rations Seen by PAW

WASHINGTON.—There is no possibility of an early increase in fuel-oil rations for householders in the Middle West and East Coast districts, according to Petroleum Administration for War. A spokesman for that agency said reserve supplies are inadequate and military demands are still heavy and may increase.

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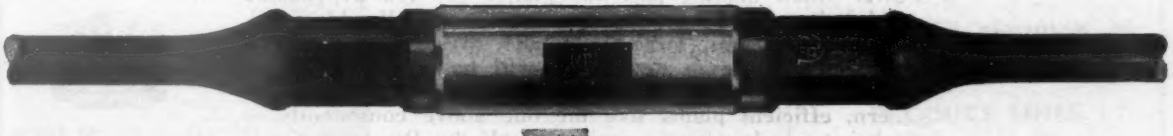

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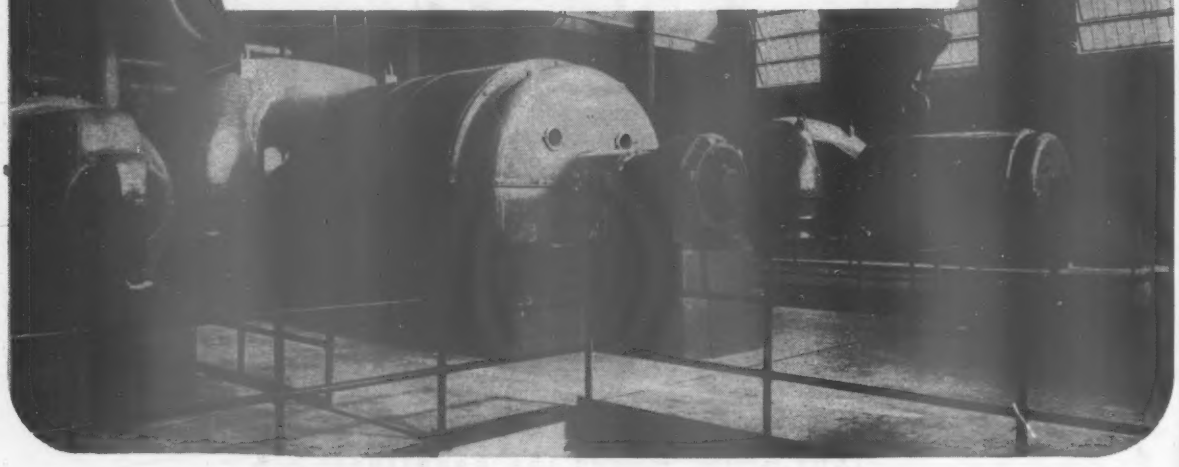

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PIPE LINES

FPC Permits Louisville To Connect With T.G.&T.

Federal Power Commission announced its order authorizing the Louisville Gas & Electric Co., Louisville, Ky., to construct and operate additional facilities, including a 65-mile pipe line to connect with the Tennessee Gas & Transmission Co.'s Texas to West Virginia pipe line recently completed. The natural gas to be transported by the proposed facilities is a supplemental supply for the company's existing system, and the operation of these facilities is required to assure maintenance of adequate natural gas service to the consumers presently served by Louisville Gas & Electric Co. The company has arranged to obtain 10,000,000 cu. ft. of natural gas daily from the Tennessee Gas & Transmission Co.'s pipe line for service in the city of Louisville and environs.

Public Service Commission of Kentucky, on July 25, 1944, approved the construction and operation of the proposed facilities, which FPC provides shall be completed not later than January 31, 1945.

Proposed facilities include (1) 62 miles of 8-in. and 3 miles of 12-in. pipe line extending from the company's Cannons Lane mixing station at the Louisville city limits to a point of interconnection near Calvary, Ky., with the Tennessee Gas & Transmission Co.'s pipe line, and (2) a cross section of 6-in. line, for emergency use only, between the applicant's existing 12-in. line and the Tennessee Gas & Transmission Co.'s 24-in. line where these lines cross in Menifee County, Kentucky.

The Louisville Gas & Electric Co. filed an application for a certificate of public convenience and necessity on August 11, 1944. A public hearing was held in Washington commencing October 19.

Dow to Lay 79-Mile Katy-Freeport Line

Dow Chemical Co. has obtained government authorization to lay a new pipe line from the Katy field, Texas, near Houston, to its chemical plant at Freeport, Tex., to move mixed liquefied petroleum gases. The line, 79 miles long, will consist of new 4-in. pipe. The cost is estimated at $842,200, including new metering and filtering facilities at Katy and high-pressure storage at Freeport. Construction time is estimated at 3 months. The line will replace high-pressure tank cars.

The line will connect with the splitter plant of Humble Oil & Refining Co. at Katy which is manufacturing isobutane and obtains a byproduct residue of liquefied petroleum gases used by Dow in making hydrogen chemicals. The line will have a daily capacity of about 2,500 bbl. of butane-propane-ethane mixture.

Metropolitan Proposes Texas-California Gas Line

A market for West Texas natural gas in the Los Angeles area of California will be sought by a new venture, Metropolitan Natural Gas Co., which proposes a 26-in. pipe line

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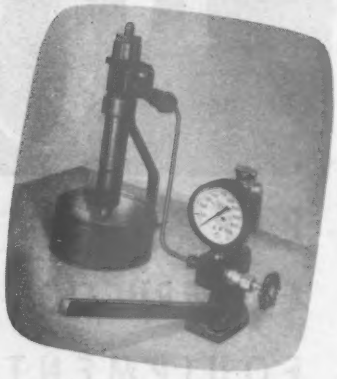

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from the Permian Basin to the Pacific Coast. Plans for the line, costing $40,000,000, with an ultimate capacity of 350,000,000 cu. ft. daily, have been discussed by C. V. Lyman, Midland oil and gas producer.

A large field compressor station is to be located in Winkler County, Texas. A natural gasoline plant is to operate in conjunction with the pipe line.

Chester A. Ring, Jr., of New York, president of Metropolitan, is preparing to present data to Federal Power Commission. Permission for construction of the line is being sought from the FPC and also the Texas Railroad Commission. Applications for the necessary critical materials have been filed with War Production Board.

Arrangements are said to have been concluded with Lyman for the supply and delivery of approximately 200,000,000 cu. ft. of gas per day, the initial load of the line.

Lyman is taking additional options on gas. The gas would be compressed, dehydrated and cleaned before going into the proposed line. Lyman explained it was a step in conserving natural-gas resources and said there was sufficient gas wasted in the air in the Permian Basin to supply the gas deficiency in the California markets.

Metropolitan, Lyman pointed out, has proposed the most favorable and direct line to California. Its field men went over the proposed route during the past few weeks. It is stated no gas will be marketed en route. The first delivery is to be made to the present gas system in the Los Angeles area.

Phillips Options Stock Of Panhandle Eastern

Phillips Petroleum Co. has granted an option on its holdings of 202,163 shares of Panhandle Eastern Pipe Line Co. common stocks to W. A. Maguire, chairman, and Hy Byrd, vice president, of Panhandle.

Frank Phillips, chairman of Phillips company, said the option is good until November 20 and the price to be paid is $50 a share or an aggregate of $10,108,150. The stock offered represents half of 404,326 shares Phillips acquired during 1943 from Columbia Oil & Gasoline Corp. at $25.81 a share.

Malco Will Lay Line in New Mexico

A 31-mile, 4-in. pipe line, to move oil out of the Caprock pool in Northwest Lea County, New Mexico, to the Dexter pipe-line station of Valley Refining Co., is to be built at once, according to information from Robert O. Anderson, president, Malco Refineries, Inc., Artesia, N. M. The Valley concern is an affiliate of Malco.

The new line will be put in by Valley Refining pipe-line division, and Murchison & Clousit Pipe Line Co., another Malco affiliate.

Approval, from both Petroleum Administration for War and War Production Board, has been granted, and the material has been acquired for the line.

The line is necessary on account of inability of the purchasers to transport the allowable production by trucks, as trucks and truck replacements are not available.

Bell-Western to Extend North Texas Line

Bell-Western Corp. has completed surveys for an extension of its pipe line from Fargo in Wilbarger County, Texas, to the new area in Block 11, H&TCRR Survey, in Wilbarger County, Texas, opened by Fain-McGaha, Wichita Falls, Tex.

Bell-Western has purchased a 5-acre site for a pumping station on the Brooks farm in the GC&SFRR Survey. The extension will consist of a 4½-in. line from the Bell's Parker station in Section 36 of Block 15 to the new station on the Brooks farm.

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Natural Gas

Memphis Natural Ordered To Pay Arkansas Tax

LITTLE ROCK.—Memphis Natural Gas Co. is not engaged solely in interstate commerce because it owns property in Arkansas, according to a ruling here last week by the state Supreme Court, which directed the company to pay the Arkansas tax on income from its holdings in that state.

A 5-to-2 decision reversed a judgment of Pulaski County chancery court dismissing an income tax claim of $6,654.77 against the corporation for 1932-41.

The opinion noted that the corporation operates a pipe line from Louisiana running through southeastern Arkansas, has a compressor station at Wilmot, Ark., and sells gas wholesale to the Arkansas Power & Light Co.

The supreme courts of Mississippi and Tennessee found the utility subject to the income-tax laws of their states, the decision said. Justices Frank Smith and McFadden dissented.

Increase in Rates Await Hearing on Legality

WASHINGTON. — Federal Power Commission will hold a hearing here November 22 on the legality of proposed increases in rates for natural gas sold by United Fuel Gas Co., Warfield Natural Gas Co. and Cincinnati Gas Transportation Co. to each other, to other subsidiaries of Columbia Gas & Electric Corp., and to nonaffiliated companies. The commission has suspended the proposed increases other than for sale of natural gas for resale for industrial use only, until April 3, 1945, or until they are made effective in the manner prescribed by the Natural Gas Act.

The commission's order consolidates, for the purpose of hearing, its investigation to determine the status of these three companies and that of Huntington Development & Gas Co. under the Natural Gas Act and the reasonableness of their rates now charged in connection with the transportation and sale of natural gas. The hearing in this matter, held October 3 and 4 and scheduled to be reconvened November 15, 1944, is postponed to November 22. All four of the companies involved are subsidiaries of Columbia Gas & Electric Corp. and have their principal offices in Charleston, W. Va.

Stating that the proposed rate increases may result in "excessive rates to the vendee companies and may place an undue burden upon ultimate consumers of natural gas," the order provides that "the burden of proof to show that the proposed increased rates are just and reasonable shall be upon the companies."

The rates provided by the new schedules would result in estimated annual increases of $3,699,000, or 22 per cent, in United Fuel's charges; $3,581,000, or 64 per cent, in Warfield's charges, and $986,000, or 23 per cent, in Cincinnati Gas Transmission's charges. Because of intercompany sales these increases are not cumulative.

Hope to Improve Facilities In West Virginia Areas

WASHINGTON. — Federal Power Commission will hold a hearing here December 12 on applications filed by Hope Natural Gas Co. of Clarksburg, W. Va., for authority to construct and operate new facilities and abandon others in several counties of West Virginia.

The proposed new facilities include four high-pressure gas compressors to replace low-pressure equipment in Lewis County, and 9.4 miles of high-pressure pipe line. Facilities to be abandoned include compressor units in Weitzel, Marion, Ritchie, Doldridge, Gilmer, and Monongalia counties.

National Fuel Planning to Buy Healey Gas Holdings

PHILADELPHIA.—National Fuel Gas Co., of Hoboken, N. J., has applied to Securities and Exchange Commission for permission to buy all of the outstanding capital stock of Jefferson County (Pennsylvania) Gas Co. for $500,000 from Healey Petroleum Corp., Bradford, Pa.

Jefferson County owns natural-gas rights and wells in Jefferson, Forest and Elk counties and purchases natural gas from nonutility independent producers in Jefferson, Forest and Clarion counties.

The gas produced and purchased is piped and sold wholesale to Pennsylvania Gas Co., a subsidiary of National Fuel, and Lora H. Cook, Cooksburg, Pa., both public utilities.

National Fuel said the acquisition would conserve Jefferson County's natural gas "for use to the best interest of the public" since deliveries "could be regulated to the demands of the ultimate consumers through the operation of wells and line pressures, the development of storage areas and curtailment of natural gas purchased by Jefferson County."

If the transaction is completed, Healey Petroleum will withdraw from natural-gas business.

Pricing Formula for Carbon Black Announced by OPA

WASHINGTON.—A special pricing formula for any additional output of easy-processing channel carbon black produced from existing facilities over and above the monthly average for the first 6 months of 1944, is announced by Office of Price Administration. The formula, effective November 8, is based on approximate total costs to produce the additional (incremental) output, and is part of an interagency program to stimulate the manufacture of this type of carbon black, urgently needed to meet the requirements of the expanding program of synthetic rubber production.

War Production Board has inaugurated a program to increase production by reopening closed-down portions of existing plants; moving equipment from old plants to locations where natural gas is available; building new plants, either by private or by Defense Plant Corp. financing, and by providing additional supplies of natural gas.

The principal material cost in this type of carbon black is the natural gas burned to produce it. Most of the current production obtains gas under long-term contracts at a price that allows production of the carbon black under existing ceilings. The gas cost for most of the additional output, however, will be substantially higher, and production under present ceilings will not be possible without incurring loss.

Prices established under the new formula will be based on approximate total production costs. Since these costs will vary substantially among the different new facilities, prices will be established separately for each one. Individual prices will be based on actual operations during a given period and apply to an amount of easy-processing channel carbon black equal to the amount of incremental output produced during the period. Until the result of actual operations is available, the producer will be permitted to sell at an estimated price.

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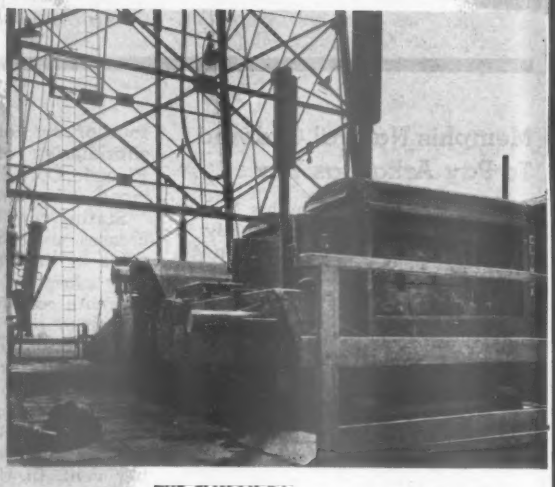

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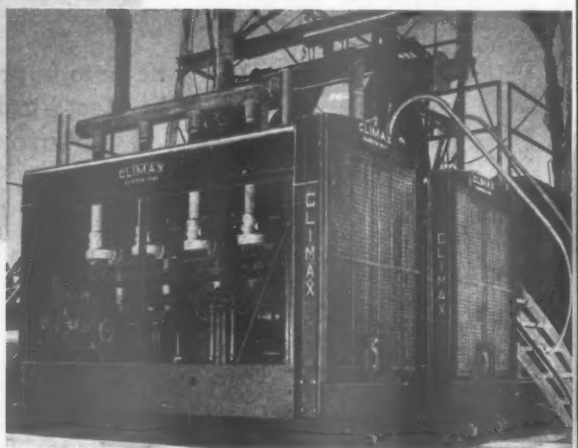

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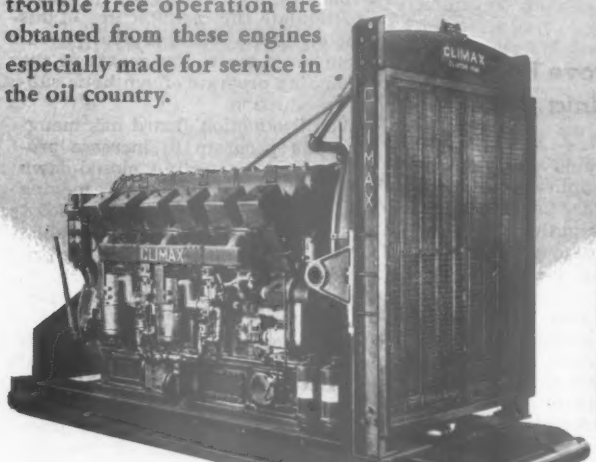

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Exploration and Drilling

Week's Highlights

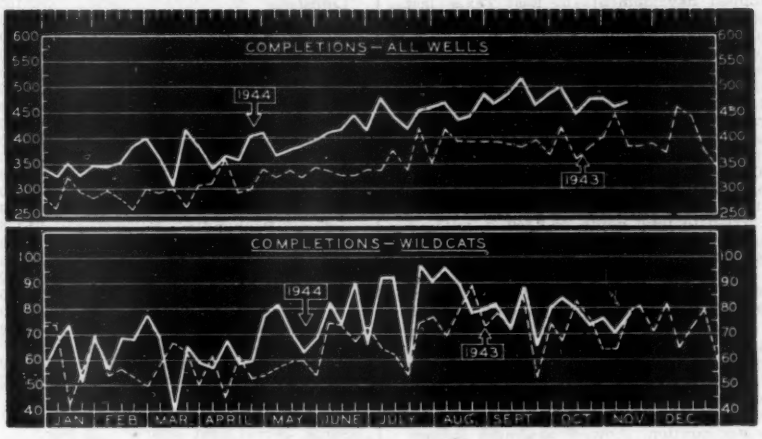
THE Wind River basin of Wyoming is back in the limelight again this week, and its future prospects begin to look as though they would live up to the most optimistic forecasts.

Sinclair-Wyoming Oil Co. et al 1 State. NW SW NW 18-28n-92w, on the Crook's Gap structure, has found light oil (37.6° gravity) in the Dakota sand at 5,232-48 ft., flowing as high as 60 bbl. per hour. Crook's Gap lies 21 miles south and 14 miles east of the Big Sand Draw gas-producing structure, on which Sinclair-Wyoming et al's deep test for Tensleep sand found saturation and an excellent showing in a drill-stem test in the Embar only a few weeks ago.

Location with respect to pipe-line outlets is an important item in Wyoming exploration, where in past years many fields were shut in because of lack of effective market demand. In this respect the two most recent Wind River basin prospects are exceptions. Sinclair has a line which runs from its refinery at Sinclair, just east of Rawlins, Wyo., to the Lost Soldier and Wertz pools in 26n-89 and 90w. The line also runs to Casper and the Salt Creek field, and is equipped to pump oil either north or south. Near its southern end, it crosses the Fort Laramie-Salt Lake City pipe line.

From an exploration standpoint, five promising structures can be tested, and if production is found, developed with the assurance that only a minimum of pipe-line construction will be required to give them outlets from the earliest stages of production. The pipe-line network is such that oil developed on these prospects could be delivered, or be available for trades, almost anywhere between Salt Lake City and Chicago.

The latest strike at Crook's Gap is only about 20 miles from the Lost Soldier terminus of the Sinclair line. A further extension of about 35 miles from Crook's Gap would tap Big Sand Draw. From Big Sand Draw it is about 10 miles northwest to Beaver Creek, a promising structure, producing shallow gas; 10 miles due north to the Alkali Butte structure, which has produced some shallow oil and gas; about 20 miles northeast to the Muskrat structure, where shallow gas has been produced.



Solid line charts current weekly completions, service wells in Eastern area not included

COMPLETIONS IN ALL FIELDS . . .

Week ended November 11, 1944

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1944	1943
N. Y., Penna., W. Va.*	51	22	51	124	184,513	†5,386	2,986
Ohio	6	8	6	20	53,800	873	810
Indiana	5	0	4	9	14,763	223	196
Kentucky	7	0	8	15	30,561	646	400
Illinois	30	0	21	51	134,065	1,653	1,536
Michigan	7	2	5	14	31,964	587	549
Kansas	18	5	27	50	162,433	1,586	1,467
Nebraska, Missouri, Iowa	0	0	0	0	0	0	43
Oklahoma	25	1	14	40	170,040	1,562	1,030
Texas:							
North Central	14	0	15	29	16,904	1,259	1,281
West	32	1	7	40	191,622	1,372	793
Panhandle	3	6	0	9	26,445	246	160
Eastern	1	0	4	5	29,753	282	251
Gulf Coast	16	5	7	28	187,770	1,090	405
Southwest	2	0	4	6	24,209	588	795
Total Texas	68	12	37	117	476,703	4,837	3,885
Louisiana:							
Northern	4	3	2	9	36,101	281	285
Southern	10	0	6	16	157,609	416	318
Total Louisiana	14	3	8	25	193,710	697	603
Arkansas	2	0	2	4	20,233	188	235
Mississippi	2	0	2	4	23,985	124	83
Southeastern States	0	0	0	0	0	44	‡
Montana	2	0	3	5	11,784	310	205
Wyoming	2	0	1	3	14,541	150	119
Colorado-Utah	0	0	0	0	0	30	22
New Mexico	6	0	1	7	28,341	347	196
California	31	0	3	34	117,925	1,729	1,178
Total United States	276	53	193	522	1,669,361	†20,972	15,343
Total previous week	284	53	134	471			
Total November 13, 1943	215	54	114	383			

*Includes 48 service wells. †Includes service wells in Appalachian area. ‡Included in total shown for Mississippi.

EASTERN TEXAS

Deep Discovery Completed In Southeastern Hopkins

DALLAS. — Completions of a deep discovery well in southeastern Hopkins County and promise of a Travis Peak sand distillate discovery in Freestone County topped developments in East Texas last week. Humble Oil & Refining Co. 1 Nichols, in the I. Friddle Survey, 2 miles south of Pickton, Hopkins County, was completed flowing 620 bbl. of oil in 24 hours through ¼-in. choke. Tubing pressure was 1,710 lb., casing pressure 1,825 lb., gas-oil ratio 1,349, gravity 50.7°. Perforations are at 7,888-96 ft., opposite the Bacon lime member of the lower Glen Rose section. The pay section was cored a few months ago, but no production test was made until last week, after the hole had been carried to total depth of 8,850 ft. without finding any additional favorable shows. Sun Oil Co. 1 Turner, about a mile northeast of this new discovery, was drilling ahead past 5,700 ft. It was reported checking about 30 ft. lower than Humble's well.

In Freestone County, The Texas Co. 1 McKnight, 2½ miles southwest of Fairfield, L. H. Reed Survey, elevation 458 ft., topped the Travis Peak at 8,000 ft. and on a 20-minute drill-stem test at 8,234-55 ft., through ¼-in. choke, using 15-stand water cushion, showed maximum surface pressure of 400 lb. Gas blew out 10 stands of water cushion, and recovery was 5 stands of water cushion, cut with gas and distillate, and 30 ft. of 58.4-gravity straw-colored distillate. Bottom-hole pressure was 3,725 lb. The crew was preparing to core ahead.

In Van Zandt County, Humble's 1 Bruce, 3 miles west and north of the Fruitvale field, topped the Travis Peak at 8,500 ft., went to total depth of 8,904 ft. and plugged back to 8,762 ft. to make a drill-stem test of sand with small oil show at 8,725-45 ft.

New wildcat locations staked during the week were J. B. Daniels et al 1 Handorf, Jos. Humphrey Survey, 5 miles north of Palestine, Anderson County, to test the Woodbine. In Houston County, 12 miles southeast of Crockett, F. K. Lytle et al 1 Watson heirs, on a 95-acre tract in the Santos Coy Survey, will be a 6,000-ft. test. Just east of Gilmer, in Upshur County, W. M. Bradley et al 1 Simpson estate, J. J. Hooper Survey, was spudded on a 5,300-ft. or Paluxy sand venture.

Bobby Manziel 1 Evans, Wood County wildcat 2 miles east of Quitman, showed only mud on a drill-stem test at 4,850-4,963 ft. in the sub-Clarksville sand and was drilling ahead below 5,200 ft.

EAST TEXAS WILDCAT COMPLETIONS

Houston County: John S. Ivy and W. T. Moran 2 G. L. Murray & Sons, John Durst Sur. A-29, 8 mi. NW Weldon, elev. 166 ft., Pecan Gap 6,815-7,185 ft., Woodbine 7,973 ft., dry, TD 8,507 ft.

Navarro County: Ryan Consolidated Petroleum Corp. 1 H. C. Redford, Hyram Bush Sur. A-46, 2 mi. NE Kerens, elev. 380 ft., Woodbine 3,485 ft., dry, TD 3,608 ft.

Rains County: C. H. Marshall, Tr., 1 O. L. Gaston, Jas. Garrett Sur., 9 mi. N Emory, elev. 463 ft., dry, TD 6,200 ft

DAILY AVERAGE PRODUCTION FOR WEEK

	Nov. 11 crude oil	Distillate, allied products	November PAW quota all oils	Nov. 4 crude oil
Arkansas	80,750	5,100	83,100	80,500
California	880,250	52,400	937,400	875,350
Colorado	9,100	.....	9,000	8,900
Eastern	68,000	8,200	80,200	67,950
Illinois	204,800	12,200	212,200	203,400
Indiana	13,100	.....	13,000	13,400
Kansas	286,000	6,000	280,000	260,200
Kentucky	30,300	2,800	28,800	30,900
Louisiana	363,150	35,000	385,000	363,950
North Louisiana	71,850	.....	.....	73,300
South Louisiana	291,300	.....	.....	290,650
Michigan	49,500	500	51,000	46,550
Mississippi	51,500	.....	50,000	49,300
Montana	23,400	400	24,400	23,400
Nebraska	1,000	.....	1,000	950
New Mexico	104,700	5,500	115,500	104,500
Oklahoma	359,400	26,900	371,900	360,000
Texas	2,132,300	145,000	2,278,000	2,132,800
East Texas	367,900	.....	.....	369,400
East Central Texas	144,600	.....	.....	146,700
North Central Texas	151,200	.....	.....	150,200
Texas Panhandle	94,150	.....	.....	96,150
West Texas	473,950	.....	.....	482,050
South Central (S. A.)	20,150	.....	.....	19,950
South Texas (Laredo)	79,300	.....	.....	78,650
Lower Gulf Coast	247,650	.....	.....	243,000
Upper Gulf Coast	553,400	.....	.....	546,700
Wyoming	94,600	3,400	103,400	97,300
Total United States	4,731,850	303,400	5,023,900	4,719,350
Change from previous week	up 12,500	.....	.....	.....

Total production January 1-November 11, 1944 ..... 1,436,973,800 bbl.
Same period last year ..... 1,251,700,410 bbl.

APPALACHIAN FIELD

Webster County Test to Try Nicholas-Upshur Trend

PITTSBURGH. — In Hacker Valley district, Webster County, Tri-State Oil & Gas Co. of West Virginia has made a location for a wildcat test on W. W. Hoover and John W. Davis tract southwest of production from the Gordon, Fourth and Benson sands production in Banks district. Upshur County. It is also northeast of the Big lime gas pool recently opened in Jefferson district, Nicholas County.

In the Jefferson district, Nicholas County, Columbian Carbon Co. is extending its recent development with another good gas well on C. C. Dickinson lease. No. 6 topped Big lime at 1,367 ft., had 2,015,000 cu. ft. of gas at 1,440-49 ft., and gaged 1,641,000 cu. ft. at 1,508 ft.

In Wyoming County, Godfrey L. Cabot, Inc., completed a good gas well in its wildcat No. 1148 Hunter and Ford, with a final gage of 2,775,000 cu. ft. The Big lime was 2,311-2,878 ft.; gas in Big lime at 2,821 ft.; Injun 2,878 ft.; Berea 3,537-71 ft.; Berea gas 3,544-66 ft. After being tubed, gas rocked up to 585 lb. in 15 minutes from total depth of 3,571 ft.

In Roane County, Jones & Boggs completed No. 3 W. M. Looney in Smithfield district as a Big lime gas well gaging 1,455,000 cu. ft. with the total depth of 2,050 ft.

In Preston County, William E. Snee et al wildcat on the Harry Sisler farm in Portland district reached 5,967 ft. or 122 ft. below the top of the Oriskany sand without any commercial showing.

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In the Otter district, Braxton County, Pittsburgh & West Virginia Gas Co. completed a fair well on E. S. Carr farm with a gage of 870,000 cu. ft. from the Injun sand topped at 2,127 ft., with gas at 2,226-35 ft., total depth 2,580 ft. In Clay County this company completed 7990 Elk River Coal & Lumber Co. with a gage of 650,000 cu. ft. gas from the First Salt sand topped at 978 ft., total depth 1,004 ft.

In Southwest Pennsylvania, the deep test of Greensboro Gas Co. No. 5 Barton on Chestnut Ridge in Wharton Township, Fayette County, is drilling at 7,002 ft., or 179 ft. below the top of the Onondaga chert, with no commercial gas showing. With the interval to the top of the chert running high in spite of possible faulting in the Marcellus, the lack of gas is unexplained, but more will be known when the Oriskany is topped. This sand should be reached shortly if the Onondaga has not thickened.

SOUTHWEST TEXAS

Bee County Wildcat Gages 80.4 Bbl. of Oil Daily

CORPUS CHRISTI.—Magnolia Petroleum Co. 1 W. E. Erp, wildcat discovery 9 miles west of Pettus in Bee County, gaged 80.4 bbl. of 35.3-gravity oil and 27.6 bbl. of salt water a day, through 7/64-in. choke, tubing pressure 700 lb., from perforations at 7,974-78 ft. Total depth is 7,605 ft.

F. B. LeFevre 1 A. Martinez et al, wildcat 12 miles southeast of Hebbronville, in Jim Hogg County, made a 45-minute drill-stem test on sand at 1,767-73 ft., with ¼-in. chokes, and recovered 804 ft. of oil, mud and some sand. Total depth is 1,773 ft. Operator set casing and is waiting for cement to set.

Transwestern Oil Co. 1 Reed & Storey, 3 miles northwest of Washburn field, in La Salle County, was abandoned as an oil test at total depth of 5,707 ft. Plug was set at 2,719-39 ft. and the company will complete as a water well in the Carrizo sand.

Texon Royalty Co. 12 Mabel Elliff, Agua Dulce field, Nueces County, was completed as a producer, testing 96.78 bbl. of 41-gravity oil a day through 5/32-in. choke, with tubing pressure 580 lb., casing pressure 1,050 lb., gas-oil ratio 1,280. This production is from perforations at 5,698-5,750 ft. Total depth is 5,750 ft.

Humble Oil & Refining Co. 4 Sauz Ranch-Mulatos Pasture, Willamar field, Willacy County, at total depth of 7,955 ft. with perforations at 7,927-40 ft., flowed 93 bbl. a day through $\frac{1}{4}$-in. choke with tubing pressure 150 lb.

SOUTHWEST TEXAS WILDCAT COMPLETIONS

Bastrop County: Phillip Boyle 1 Mollie Ingram, John Maximillian Sur., 3 mi. S of Redrock, dry at 2,971 ft.

Marts & Beaven, Inc., and O. W. Killam 1 Mrs. Addie Mae Powell, 3 mi. NW of Bastrop, in J. M. Bangs Sur., dry at 3,575 ft.

Bee County: Magnolia 1 W. E. Erp, J. B. Atkinson Sur., 9 mi. W of Pettus, TD 7,605 ft., perf. 7,974-78 ft., PT 80.4 bbl. net oil and 37.6 bbl. salt water, through 7/64-in. choke, TP 700 lb., gravity 35.3, 27.6 bbl. water. Discovery.

La Salle County: Transwestern 1 D. C. Reed and H. C. Storey, A. Sullivan Sur., 3 mi. NW of Washburn field, dry at 5,707 ft. (Completing as water well in Carrizo.)

Starr County: Drilling & Exploration Co., Inc., 1 A. M. Kelsey, 4 mi. NW of El Sauz, in BS&F Sur. 125, dry at 3,026 ft.

TEXAS GULF COAST

Matagorda County Wildcat Continues Testing

HOUSTON.—Skelly Oil Co. 1 Granbury-Fullilove, wildcat 3 miles northeast of Van Vleck in Matagorda County, flowed oil and water through perforations at 8,767-69 ft. Additional perforations were made at 8,769-71 ft. and the well continued to show oil and water. Operators are preparing to squeeze perforations at 8,767-71 ft. to perforate higher for a new test. Total depth is 10,010 ft.

Sun Sun Oil Co. 3-B Braman et al, outpost at North Bay City field, Matagorda County, flowed potential of 329 bbl. of 35.6-gravity oil through 10/64-in. choke, gas-oil ratio 615, from perforations at 7,873-76 ft., with 0.1 per cent water. Total depth is 8,500 ft., top of sand 7,859 ft. and 5½-in. casing set at 8,787 ft.

Glenn H. McCarthy et al 1 Burrell et al, east extension test at Fannett field, in Jefferson County, flowed 433 bbl. of 33.6-gravity oil through 11/64-in. choke, gas-oil ratio 425, tubing pressure 1,100 lb., casing pressure 1,200 lb. from perforations at 7,296-7,302 ft. Total depth is 8,050 ft. with 7⅝-in. casing set at 8,050 ft. McCarthy's 1 H. Reichert, wildcat about a mile west of the Eltex, Ltd., producer at Spring, Harris County, was abandoned at total depth of 6,800 ft. after failing to find anything of interest in the 6,200-ft. Cockfield zone.

G. W. Strake 1-W P. G. Korhn "B," southwest side of Conroe field, Montgomery County, is coring ahead below 9,416 ft. in sands showing gas with condensate odor in the Wilcox. It attempted to blow out at 9,597 ft., showing gas, but was controlled and heavier mud was intro-

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duced. Wilcox was topped at 8,010 ft.

Sinclair Prairie Oil Co. 1 John Atkinson, Texana field, Jackson County, was completed for a gas well good for 1,750,000 cu. ft. a day on ½-in. choke, tubing pressure 2,075 lb., from perforations at 5,505-08 ft. Total depth is 7,807 ft.

Gem Oil Co. 5 Kavanaugh & Collins, new Sparta producer at Livingston field, Polk County, flowed a potential of 154.44 bbl. day through ¼-in. choke, gas-oil ratio 740, tubing pressure 190 lb., casing pressure 1,125 lb., from perforations in the Sparta sand, topped at 6,058 ft. This well had been drilled to 6,942 ft. in the Wilcox, and 5½-in. casing was set at 6,220 ft. for completion.

General Crude Oil Co. 2 Security Bank & Trust Co., 4 miles southwest of Lane City, in Wharton County, ran a new test in perforations at 5,341-51 ft., flowed at the rate of 108 bbl. a day through 5/32-in. choke, with tubing pressure 700 lb., but went to 70 per cent water, squeezed perforations and is waiting for cement to set.

TEXAS UPPER GULF COAST WILDCAT COMPLETIONS

Fort Bend County: Westland Oil Co. 1 R. M. Caldwell, 1 mi. E of Hawdon, in W. S. Hall League, Abstract 31, dry at 6,505 ft.

Galveston County: Skelly 1 Robert E. Paine, 2 mi. S of Friendswood, Sarah McKissick League, dry at 6,754 ft.

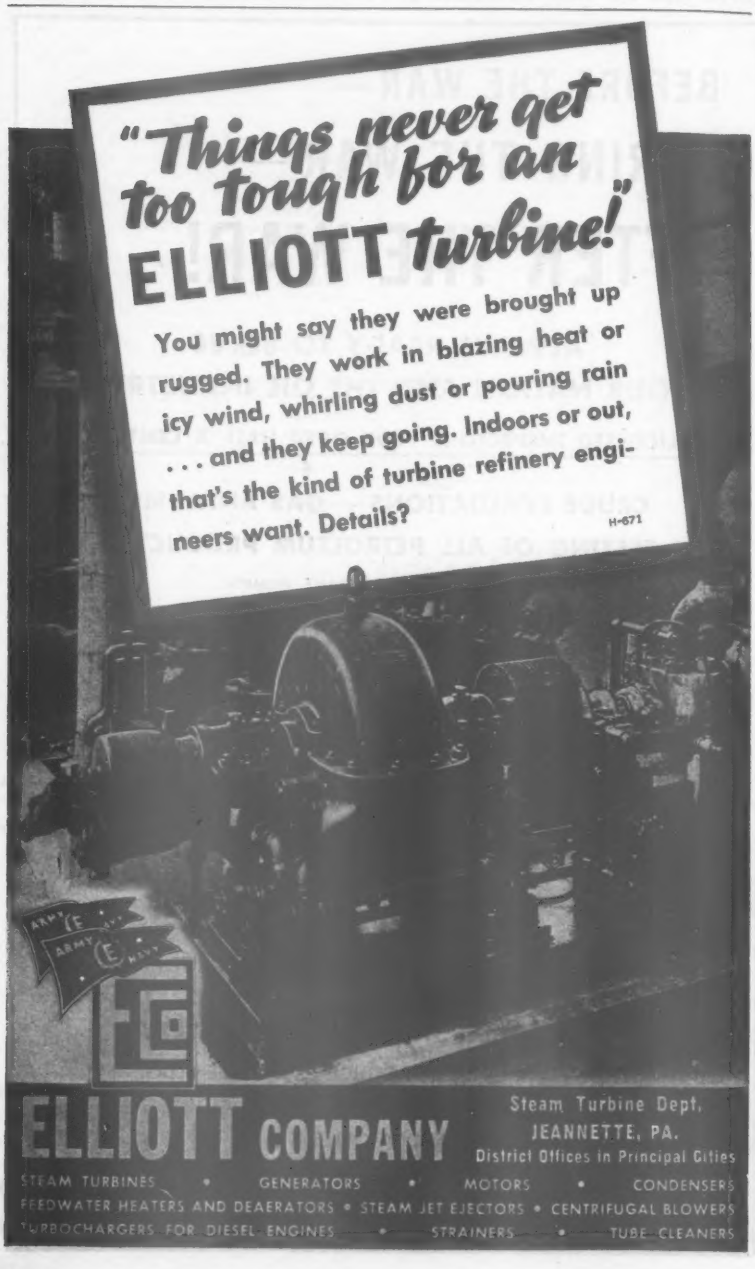
Hardin County: Houston Oil Co. of Texas and American Republics Corp. 1 fee-Hardin County School Land fee, 5 mi. S. of Warren, TD 7,006 ft., 5½-in. casing at 5,880 ft., 2-in. at 5,770 ft., perf. 5,798-5,812 ft., PT 47,000,000 cu. ft. gas open flow, SITP 2,050 lb., CP 2,200 lb., on 9/64-in. choke. Discovery.

Harris County: Eltex, Ltd. Mrs. Anna Scott, Westfield area, HT&B Sur. 1, dry at 7,496 ft.

J. E. Ludeau 1 Overly estate, 10 mi. N of Houston, in Wiley Smith Sur., Abstract 711, dry at 4,092 ft.

Glenn H. McCarthy 1 H. Reichart, Spring area, A. Scales Sur. 687, dry at 6,800 ft.

Jackson County: Humble 1 I. B. Clements et al, John J. Linn Sur., ⅜ mi. SE of El Toro, dry at 6,863 ft.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SOUTH LOUISIANA

New Production Opened on Old West Gueydan Dome

NEW ORLEANS. — Pure Oil Co. 1 Ferguson-Benoit unit opened oil production on the southeast flank of the old West Gueydan dome in Vermilion Parish, flowing 213 bbl. of 36.9-gravity oil daily with 120,000 cu. ft. of gas on ½-in. choke. Tubing pressure was 1,500 lb. Total depth is 10,806 ft. with plugged-back total depth 9,624 ft. Perforations are at 9,619-23 ft.

Continental Oil Co. opened condensate production in the South Lake Charles area of Calcasieu Parish at 1 Glen Greathouse et al. Drilled to 11,019 ft., and perforated at 10,018-26 ft., the well flowed 130 bbl. of 52.9-gravity condensate on 11/64-in. choke, with 1,639,000 cu. ft. of gas. Tubing pressure was 3,300 lb. No water was reported, and the well shut in for completion.

The Avery Island field, Iberia Parish, which has several wells completed in the 8,900-ft. sand and one in a sand at 10,162 ft., shows production in a third sand at the 9,500-ft. level. Humble Oil & Refining Co. 2-B Petit Anse Co., which went to total depth of 10,537 ft. in salt then plugged back and perforated at 9,515-18 ft., is flowing 216 bbl. through 5/32-in. choke, with gas-oil ratio of 4,665, tubing pressure 2,700 lb. and gravity 35.5°. It is still testing.

Humble's 1 Robinson, at Laurel Ridge field, Iberville Parish, squeezed perforations at 10,651-53 ft. It shows top of cement at 10,623 ft. and is preparing to reperforate for a new test. It had flowed 70 per cent oil and 30 per cent salt water on ⅛-in. choke, tubing pressure 1,600 lb., at the 10,651-ft. level.

Stanolind Oil & Gas Co. 1 Bella Nickerson, on the northwest flank of the Anse la Butte field in St. Martin Parish, flowed 203 bbl. daily from perforations at 10,995-11,025 ft. through 9/64-in. choke, gas-oil ratio 321, tubing pressure 1,120 lb. Gravity of the oil is 28°, no water was reported in the flow. Total depth of the hole is 11,920 ft. with 7-in. liner set at 8,671-11,232 ft. for completion. The 2-in. tubing is set to 10,957 ft.

Magnolia Petroleum Co. 1-D H. Reese at West Gueydan field, Vermilion Parish, flowed at the rate of 200 bbl. a day on ½-in. choke, gravity 37.8°, but went to salt water through perforations at 10,430-45 ft. Operators squeezed perforations to reperforate for a new test.

SOUTH LOUISIANA WILDCAT COMPLETIONS

Acadia Parish: Phillips 1 Onezime, Crowley area, 16-10s-1e, 33 bbl. through 11/64-in. choke, 2,520,000 cu. ft. gas, TP 3,300 lb., gas-oil ratio 77,000, perf. 9,738-41 ft., TD 10,000 ft. Discovery.

St. Mary Parish: Humble 1-F Miami Corp., Black Crook Bayou area, in West Cote Blanche Bay-15s-8e, dry at 12,041 ft.

Terrebonne Parish: Sun 1 Blanchard pool, 43-17s-16e, dry at 11,015 ft.

Vermilion Parish: Pure 1 Ferguson-Benoit unit, West Gueydan, 5-12s-2w, 213 bbl. through ½-in. choke, 120,000 cu. ft. gas, TP 1,500 lb., perf. 9,619-23 ft., TD 10,806 ft., PB TD 9,624 ft. Southeast flank discovery.

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PERMIAN BASIN

Humble Test Doubles Yield After Being Reacidized

MIDLAND.—Humble Oil & Refining Co. 1 Jackson, southeastern Lamb County wildcat, 30 miles north of the Slaughter field, doubled its production after reacidizing with 10,000 gal., swabbing 12 bbl. of fluid per hour, with a little mud and acid water. It had swabbed 5 bbl. following initial treatment with 5,000 gal. The production is coming from 658 ft. of open hole in the lower Permian lime section, between the casing seat at 5,348 ft. and the plugged-back depth 6,006 ft. Woodley Petroleum Co. 1 Bird, 5½ miles northwest of Humble's well, was drilling past 6,470 ft. in lime.

To the southwest of this area, in Lubbock County, Seaboard Oil Co. and Stanolind Oil & Gas Co. 1 Cravens, in Section 16, Block D, LS&V Survey, recovered 2 ft. of free black oil, 60 ft. of oily mud and 120 ft. of drilling mud on a 60-minute drill-stem test at 6,048-6,116 ft. and it was drilling ahead below 6,190 ft. on its new 8,000-ft. contract.

Fikes & Murchison 1 Alexander, Terry County wildcat about 7 miles south of the Slaughter field, in Section 18, Block K, PSL Survey, has cemented 7-in. casing after coring from 5,109-27 ft., recovering 2 ft. of dolomite with stains in spots. It will rig up cable tools to drill ahead.

A new 6,000 ft. wildcat for southeastern Gaines County was staked at Rowan Drilling Co. 1 H. C. Shumaker, in the southwest corner of Labor 2, League 298, Reagan County School Lands. Shell Oil Co., Inc. 1 Sparks, southwestern Gaines County, was drilling below 10,409 ft. in dolomite with no further shows reported. Humble's 1 Doss, new lower Permian lime discovery 7 miles southwest of Seminole, flowed 12 bbl. of oil per hour, on a 14-hour test. Pay at 7,030-80 ft. was treated with 6,000 gal. of acid.

Extending the Fullerton field, Andrews County, a quarter mile east, Frankel Bros. 2-D University, Section 3, Block 13, made 1,686 bbl. of oil daily on potential test from pay zone at 6,740-6,966 ft. Magnolia Petroleum Co. 1 University, in Section 11, a mile southeast of Fullerton production, was drilling plugs from casing at 6,910 ft. and appeared assured of production.

Atlantic Refining Co. 1 TAR, east outpost to the Crossett pool on the Crane-Upton County line, was completed for 536 bbl. of 44.2-gravity oil daily through ½-in. choke, after acidizing the Devonian lime pay section at 5,348-5,420 ft. Total depth is 5,500 ft. The Texas Co. 3-B Hobbs, in Section 33, Block 35, 1½ miles northwest of the Crossett pool, recovered 1,142 ft. of gas-cut drilling mud with a slight show of distillate on an 85-minute drill-stem test at 5,738-5,872 ft., in the Ordovician. It logged only small shows in the Devonian, producing horizon of the pool.

WEST TEXAS WILDCAT COMPLETIONS

Crockett County: Standard Oil Co. of Texas 1 University, Sec. 25, Blk. 12, University lands, 1 mi. SW Barnhart pool, elev. 2,651 ft., dry, TD 2,608 ft.

Culberson County: Humble Oil & Refg. Co. 1-B Reynolds Cattle Co., Sec. 33, Blk 26, PSL, 10 mi. NE Plateau, elev. 5,060 ft., dry, TD 5,417 ft.

Howard County: Ray A. Albaugh 1 fee-McMurray, Sec. 29, Blk. 32, T-2-N, T&P Sur., 11 mi. N Big Spring, elev. 2,684 ft., Grayburg 2,960 ft., San Andres 3,260 ft., dry, TD 5,010 ft.

Midland County: Richfield Oil Corp. 1 Mrs. Annie S. Boones, Sec. 44, Blk 36, T-2-S, T&P Sur., 23 mi. E Midland, elev. 2,614 ft., dry, TD 4,508 ft.

Pecos County: Ungren & Frazier 1 Jasper County, Blk. 104, Jasper CSL, elev. 3,220 ft., dry, TD 2,792 ft.

Upton County: T. P. Coal & Oil Co. 1 Isabella Morrison, Sec. 29, C&MRR Sur., 2 mi. N Rankin, elev. 2,607 ft., dry, TD 4,101 ft.

Ward County: Lion Oil & Refg. Co. 1-B University, Sec. 43, Blk. 18, University lands, 3 mi. W Pyote, elev. 2,655 ft., Delaware 4,940 ft., flowed 122 bbl. day through 24/64-in. choke on tubing, TD 4,994 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—Humble Oil & Refining Co. 1 Federal-Leonard Oil Co., southeastern Lea County, was reperforated last week with two additional shots per foot in the zone previously perforated, at 11,890-11,928 ft. It failed to flow. When treated with 2,000 gal. of acid it started flowing at the rate of 32 bbl. of oil per hour, but at the close of the week was making only 14 bbl. per hour, with 11 per cent water. There was 200 lb. pressure on tubing, and 850 lb. on casing. Casing has not yet been perforated opposite the upper part of the Ellenburger pay section. Continental Oil Co. 2-B-23 Skaggs, Ordovician wildcat east of Monument, was preparing to drill out cement from 7-in. pipe landed at total depth of 10,465 ft. in granite. Atlantic Refining Co. 1 Stephens, 33-14-33, 15 miles northwest of Lovington, logged base salt at 2,470 ft., top of frosted quartz grains 2,620 ft., and was drilling below 3,400 ft.

SOUTHEASTERN NEW MEXICO WILDCAT COMPLETIONS

Lea County: Gulf Oil Corp. 1 Vivian, 30-22s-38e, elev. 3,343 ft., Glorietta 5,130 ft., Tubbs 6,375 ft., top pay 6,375 ft., flowed 1,341 bbl. day, TD 6,508 ft.

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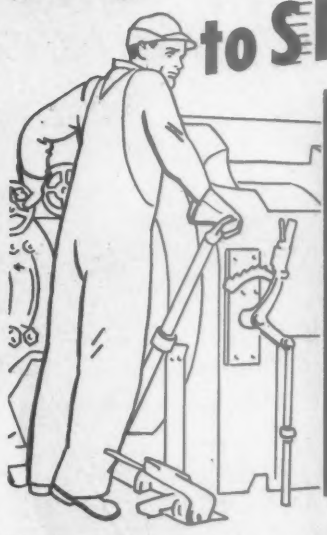

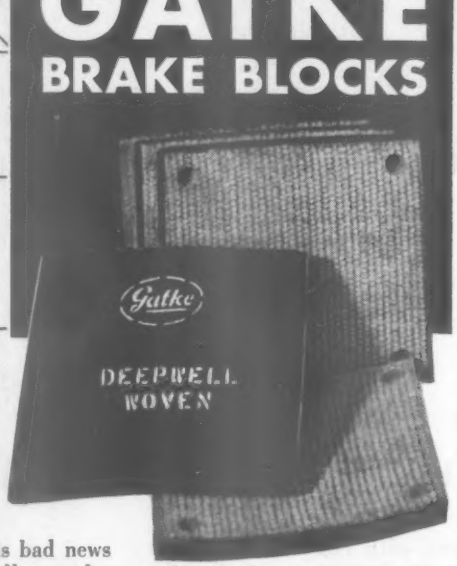

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ILLINOIS

Wabash and White County Wildcats Produce Oil

CENTRALIA, Ill.—Fifty-one wells were completed in Illinois during the past week of which 20 were oil wells averaging 126 bbl. per day per well. The largest initial producer was Superior Oil Co. 2 P. Price, SE SE SW 19-1s-2e, Boyd pool, Jefferson County, which produced 385 bbl. of oil, but with 165 bbl. of water, from Benoist sand at 2,026-45 ft. and Aux Vases sand at 2,094-2,103 ft. Total depth was 2,134 ft., with an 80-qt. shot at 2,105-34 ft.

Among the wildcat completions were two that showed production. Kingwood Oil Co. 1 G. Iles, in 4-2s-14w, Wabash County, pumped 12 bbl. of oil and 41 bbl. of water from McClosky lime at 3,013-3,103 ft., at intervals, the oil coming from above 3,020 ft. Great Lakes 1 S. H. Tully, SW NW SW 8-7s-10e, White County, pumped 47 bbl. in 24 hours from Tar Springs sand at 2,279-87 ft., which had been shot with 60 qt.

Thirty-five new operations were started during the week, including 9 wildcats as follows: Magnolia Petroleum Co. 1 Prater estate, NW NW NW 31-7n-2w, and Homer Luttrell 1 J. H. Ulmet, SE NW SW 8-4n-3w, Bond County; Al Schierman et al 2 Jansen, SW NW NE 32-2n-2w, Clinton County; Cain Syndicate 1 Leathe, 1,150 ft. from N and 900 ft. from W lines, N½, frac. SW¼ 7-3n-9e, and Texas Co. 1 C. E. Wright, NE SW NW 24-4n-10e, Richland County; Sinclair Wyoming 1 Leo Haught, SW SE NW 5-2n-6e, Clay County; Ohio Oil Co. 1 Spangler, SE SE NW 1-1n-3e, Marion County, and Sinclair Wyoming 1 E. Harris, NW SW NE 21-3s-4e, Jefferson County.

ILLINOIS WILDCAT COMPLETIONS

Clinton County: Joe May 1 Carlyle Community Park, NW NW NW 31-2n-2w, dry at 1,246 ft., Golconda 912 ft., Cypress 1,058 ft., Benoist 1,164 ft., Benoist sand 1,178 ft.

Edwards County: Superior 1 Cowling, SE SW NE 21-1s-14w, dry at 3,079 ft., Meard 2,210 ft., Cypress 2,676 ft., Weiler 2,748 ft., Aux Vases 2,959 ft., McClosky 3,055 ft.

Effingham County: Harry Sherman and Lane 1 H. Niemerg, SW SW SW 16-7n-7e, dry at 2,810 ft., Glen Dean 2,238 ft., Cypress 2,454 ft., Ste. Genevieve 2,691 ft., Fredonia 2,725 ft.

Hamilton County: Magnolia 1 A. G. Haas, NW NW SW 16-4s-6e, Menard 2,548 ft., Cypress 3,048 ft., Renault 3,324 ft., Ste. Genevieve 3,384 ft.

Jasper County: Pure 1 L. F. Arnold B, NE NE NE 14-6n-10e, dry at 2,808 ft., Vienna 2,093 ft., Benoist 2,541 ft., Aux Vases 2,617 ft., McClosky 2,730 ft., St. Louis 2,790 ft.

McDonough County: Northern Ordnance 1 Champion, NE NE SW 9-6n-3w, of fourth principal meridian, dry at 642 ft.

Madison County: Joe Kisl 1 Whitmore heirs, C SW SW 25-5n-6w, dry at 2,025 ft., Devonian lime top 1,910 ft.

Wabash County: Kingwood 1 Iles, NW NW SE 4-2s-14w, McClosky lime 3,013-19, 3,029-33 and 3,099-3,103 ft., TD 3,112 ft., PB to 3,020 ft., pumped 12 bbl. oil and 41 bbl. water in 24 hours.

Wayne County: Sinclair Wyoming 1 J. E. Milliner, NW NE NE 31-1n-6e, dry at 3,314 ft., Menard 2,405 ft., Cypress 2,850 ft., Benoist 3,056 ft., Aux Vases 3,144 ft., McClosky 3,229 ft.

White County: Great Lakes 1 S. H. Tully, SW NW SW 8-7s-10e, Tar Springs sand at 2,279-87 ft., TD 3,047 ft., sand shot with 60 qt., pumped 47 bbl. of oil in 24 hours, opening a pool.

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OKLAHOMA

W. Edmond Wells Testing Lower Hunton Section

THE Chimney Hill section of the Hunton lime, below the Bois d'Arc section that is now yielding big wells, is drawing increasing interest from West Edmond operators. Stanolind Oil & Gas Co. 1 Pauly, NW NW 27-14n-4w, drilled below the Bois d'Arc and after acidizing the Chimney Hill, swabbed 261 bbl. of oil in 16 hours. The well was then plugged back and completed in the Bois d'Arc, where it flowed 245 bbl. of oil in 5 hours. Sinclair Prairie Oil Co. 1 O'Brien, NE NW 9-14n-4w, set pipe through the Bois d'Arc at 6,711 ft., drilled to 6,941 ft., and will acidize and test the Chimney Hill. Phillips Petroleum Co. 2 Crookham, SE SE 17-13n-4w, has acidized and is testing the Chimney Hill section at 7,100-7,120 ft.

Gas-oil ratio tests were started at West Edmond over the week end, and on Monday the key wells selected for bottom-hole pressure tests were shut in, with the tests being made Wednesday.

Total number of producing wells at the end of last week was 231 oil wells and 1 gas well, of which 5 oil wells and 1 gas well were Bartlesville sand producers, the remainder Hunton lime. Pipe-line runs were 44,800 bbl. daily from 217 connected wells.

Cleveland County.—The Crosbie-Warren 1 Stotts, NE NE SE 30-10n-3w, which changed the outlook for the West Moore pool, drilled out cement plug and on test started flowing and cleaning itself. Both rate of flow and pressure seemed to be increasing, tubing pressure increasing from 650 lb. to 1,125 lb., and back pressure on separator stepped up from 200 to 375 lb. Late reports indicated a minimum flow of 25 bbl. per hour through a ¼-in. choke.

Mid-Continent Petroleum Corp. 2 Westermier, NE NW SW 26-10s-3w, offset to the discovery well in the South Moore pool, drilled to total depth of 8,845 ft., set casing at 8,780 ft., and is preparing to drill out cement to test. It is reported checking 24 ft. higher on the Wilcox than the discovery well.

Garvin County.—Skelly Oil et al 1 Rakestraw, SE SW SE 4-4n-3e, north of Stratford, found first and second Wilcox sands dry at 3,334 and 3,392 ft., respectively, and is plugging back to test Pennsylvanian sand zones between 2,500 to 2,800 ft.

Logan County.—Phillips Petroleum and Carter Oil Co. 1 Dublin, NE NE 18-15n-4w, 2 miles north of the West Edmond field, is drilling at about 6,700 ft. This test is being watched to see if the West Edmond field will continue that far north.

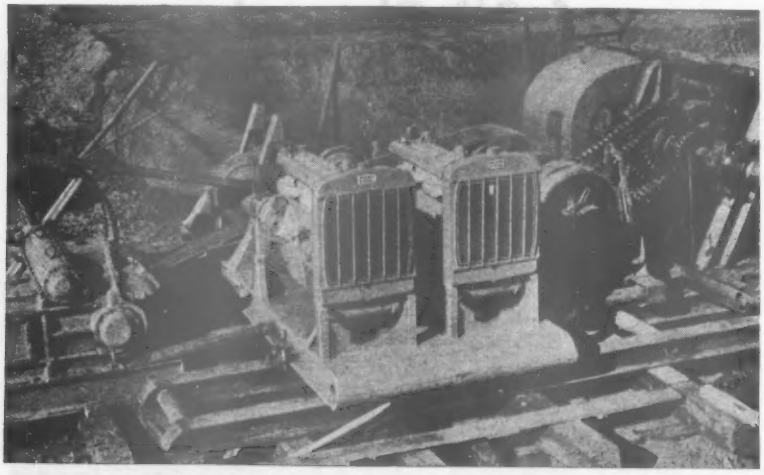
McClain County.—Carter Oil Co. 1 Lamar ranch, NE SW 28-8n-3w, topped the Hunton lime at 9,978 ft., and was still drilling in Hunton at 10,114 ft., with no shows. This test is about 2 miles north of Carter's 1 Cottingham, the Washington pool discovery in Wilcox sand. The Lamar ranch test was started immediately after the Washington pool was opened.

OKLAHOMA WILDCAT COMPLETIONS

Atoka County: Burns Oil 1 Zwiegel, NE SW NW 16-3s-10e, dry, TD 4,335 ft., McLish, 3,865 ft.

Carter County: W. H. Smith 1 fee, NW NW NE 8-5s-1w, pumped 100 bbl. oil and 20 bbl. water, gravity 28° to 30°, from pay zone 3,620-4,208 ft., TD 4,360 ft., in sand.

McClain County: Carter 1 Johnson, SW SE 30-8n-2w, flowed 322 bbl. fluid, 3½ per cent water, in 22 hours, gravity 40°, from pay zone 8,190-8,200 ft., TD 8,222 ft., Trenton 7,840 ft., Bromite sand 8,190 ft.



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OHIO, KENTUCKY

Third Gas Well in Lorain County Pool Completed

COLUMBUS.—Glenn Harmon has drilled in a well producing 9,822,000 cu. ft. of gas daily in the newly discovered pool in Huntington Township, Lorain County. The completion, 2 N. B. Griggs, Tr. 12, had 13 ft. of sand at 2,460-2,473 ft. This is the third gas completion in the pool, all having large initial open flows.

The Middle Wellington pool was extended over into Penfield Township by Ohio Fuel Gas Co. 1 W. A. Brouse, Lot 6. The First Clinton sand at 2,368-2,376 ft. gaged 2,940,000 cu. ft. The gas volume prevented drilling to the lower sand.

Belden et al 1 John De Ford, Section 31, Canton Township, Stark County, gaged 591,000 cu. ft. in the white Clinton at 4,654-4,676 ft. and was shut in after being shot and producing 1,000,000 cu ft. with 1,350 lb. pressure.

The Ohio Oil Co. found 274,000 cu. ft. of gas and a show of oil in the St. Peters at 4,416-4,428 ft. in the wildcat it is drilling in Ruggles Township, Ashland County.

East Ohio Gas Co. is drilling in the Oriskany sand in its wildcat in Lawrence County with only a small gas show found.

Frank Lyons found 2,000,000 cu. ft. of gas in the Berea sand at 1,003-1,011 ft. in a wildcat test going to the Oriskany in Tuscarawas County. Gas was cased off and drilling continued.

OHIO WILDCAT COMPLETIONS

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Oklahoma and Kansas: W. R. Brown, Box 3218, Tulsa

Texas, Louisiana, New Mexico: R. M. White, 823 Neil P. Anderson Bldg., Fort Worth, Tex.

East Ohio 1 G. B. Smith, Sec. 35, dry at 4,305 ft.

Muskingum County, Newton Township: Industrial Gas 1 Melton Schneider, Sec. 11, dry at 3,651 ft.

WESTERN KENTUCKY

OWENSBORO, Ky.—W. F. Lacey 1 T. T. Williams, a mile south of Mount Vernon, Ind., but in 4-Q-20, Henderson County, Kentucky, was due for a test of McClosky lime at about 2,750 ft., after having shown signs of production in Pennsylvania sands at intervals from 890 to 1,310 ft. and good saturation in Waltersburg sand at 1,870-86 ft. A drill-stem test of the Waltersburg developed 480 ft. of salt water, but good saturation in the core, so the test may have covered too much of the formation.

Five oil wells and seven dry holes were reported completed during the week.

A wildcat 2 miles south of Sturgis, Union County, and 12 miles from production, Farmer and Basin Drilling Co. 1 W. W. Slaton, 17-M-19, filled 600 ft. with oil from Hardinsburg sand at 1,348-60½ ft. It pumped oil at the rate of 18 bbl. per day, without a shot.

WESTERN KENTUCKY WILDCATS

Henderson County: National Associated 1 F. R. Callis, 4-O-23, dry at 2,265 ft. Cypress sand 2,235-65 ft.

McLean County: Ohio Oil 1 J. H. Thomas, NW SE 25-L-28, dry at 2,270 ft. Glen Dean 1,642 ft., Barlow 1,861 ft., Paint Creek 1,915 ft., Renault 1,975 ft., Ste. Genevieve 2,038 ft.

EASTERN KENTUCKY

ASHLAND.—Operations in the eastern Kentucky area maintained a steady pace during the week but completions dropped to a low point. Two small oil wells were drilled in and one dry hole was included in the reports.

Kentucky Oil Producers hit a 6-bbl. well in No. 3 on the John Rose tract, Johnson County, at total depth of 851 ft.

Virginia Gas & Oil Co. has a light producer in No. 2 on the Lafe Stepp tract, Dry Creek, in Wolf County.

Inland Gas Corp. got a dry hole in No. 265 on the Virginia-Kentucky Coal Corp. land, Bulls Fork, in Knott County, at total depth of 1,642 ft. in Maxon.

INDIANA

EVANSVILLE, Ind.—Five oil wells and four dry holes were completed in the past week. Ashland Refining Co. et al completed two 200-bbl. wells on Nos. 2 and 3 Spencer in 32-6s-14w, Lupton pool, Posey County.

INDIANA WILDCAT COMPLETION

Vanderburgh County: Sun 1 Tony Seib, NE NW SE 22-5s-11w, dry at 2,544 ft. Lower Glen Dean 1,896 ft., Barlow 2,158 ft., Ste. Genevieve 2,448 ft.

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CANADIAN FIELDS

S. Turner Valley to Get Joint Venture Deep Test

CHATHAM.—In South Turner Valley, Okalta Oils 7, LSD 3, 18-18-2w5, completed in 1939 at 7,310 ft., with 322-bbl. initial production from the Madison limestone, will be deepened as a joint test by several Turner Valley companies. Main objective is to determine conditions below the east-side fault encountered in National Petroleum 2 and Major-National 16, with possibility of getting the second lime occurrence found on the east side of the North Turner Valley extension.

Taber.—In the Taber field, California Standard 67-15-A, LSD 14, 15-9-17w4, TD 3,201 ft., was completed with 175 bbl. initial production.

Conrad.—Conrad-Province 77-33-B, SE 13, 33-5-15w4, TD 3,079 ft., is installing pump; 55-33-B, LSD 11, 33-5-15w4, is starting, and 55-21-B, LSD 11, 21-5-15w4, is moving rig.

Plains drilling.—The marked shift in Alberta drilling is emphasized by a recent summary which shows only eight wells drilling in Turner Valley, with six testing and two new licenses, while outside fields have 24 drilling, 3 testing, 1 finished, 2 spudded and 8 new drilling licenses. Recent development in the plains areas, particularly in the Taber and Steveville-Princess fields, have shifted attention to those areas, with growing interest indicated in the testing of the Devonian limestone.

Eureka.—California Standard Eureka 1, LSD 9, 19-18-13w4, has been abandoned at 3,258 ft. on top of the Madison limestone.

Birdsholm.—Birdsholm-Province 1, LSD 14, 33-4-11w4, TD 3,131 ft., has been abandoned in top of Madison.

Turner Valley.—Imperial-Hudson's Bay 17, LSD 16, 8-21-3w5, TD 9,696 ft., Madison 9,510 ft., abandoned.

Lloydminster.—In the Lloydminster field, eastern Alberta, Silverdale 1, LSD 10, 12-49-1w4, TD 1,898 ft., extended the field 4 miles south and east. An 18-ft. sand was met and bailing five days failed to lower the oil level. Numerous other tests are being started in the field.

Saskatchewan.—Since 1939 a systematic search for oil, mainly financed by Imperial Oil and associated interests, has been in progress in the province of Saskatchewan. Seven deep wells, totaling 49,600 ft., with the deepest 9,400 ft., have been drilled by Norcanols Oil & Gas, Imperial and associated companies, getting no commercial production, though oil shows were encountered. Drilling was preceded by geological, seismograph, gravity-meter and other surveys, with extensive core drill-

ing, upwards of 54,600 sq. miles being covered, all in the southern part of the province. Two deep tests are still drilling, Norcanols-Buffalo Gap 1, LSD 16, 3-3-25w2, at 7,693 ft. and Imperial-Swift Current 1, LSD 11, 20-13-13w3, at 4,727 ft.

ROCKY MOUNTAIN

Steamboat Butte Structure Yields New Oil Sand

DENVER.—A third producing sand, the Lakota, has been discovered on the Steamboat Butte structure, Fremont County, Wyoming, in British American Oil Producing Co. 4-E Tribal, NE SE NW 5-3n-1w, ½ mile southeast of the same company's 1-E Tribal, completed early in 1943 for 600 bbl. daily from the Sundance sand at 5,099-5,118 ft. oil in 4-E Tribal was found in the Lakota sand, topped at 4,493 ft. On drill-stem test at 4,506-62 ft., open 45 minutes, the well showed 3,906 ft. of 38-gravity sweet oil and 100 ft. of drilling mud. The casing is being set through the Lakota on top of the Sundance.

The second discovery in this field was made in the Tensleep last April, when 2-C Tribal was completed at 7,034 ft. and made 570 bbl. on the pump. The Sundance sand discovery, first in the field, went through the Lakota sand at 4,447-65 ft., and on a drill-stem test made only 150 ft. of oil-cut mud with 3 gal. of free oil on top. Although the field now has three proven oil-producing horizons, its possibilities in other sands are not to be overlooked. In the Sundance sand discovery well considerable gas was found in the first and third Frontier sands.

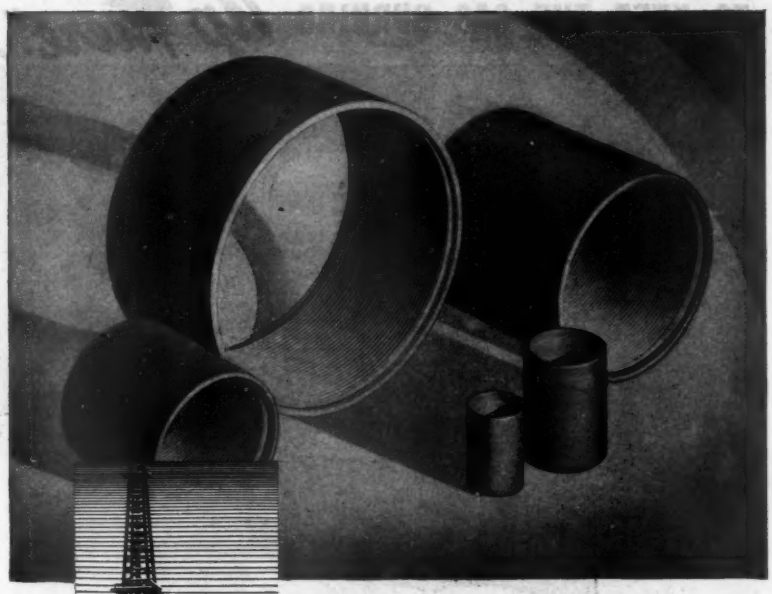
Kirby Creek discovery.—Pacific Western Oil Corp. has opened a small black-oil pool in the Embar in its 1 Government, Kirby Creek structure, Hot Springs County, Wyoming. The Embar lime, topped at 3,418 ft., showed some saturation in the cores. Drilling continued, however, through the Tensleep into the Madison, topped at 4,342 ft. These two horizons showed only water. The well then was plugged back to the Embar and casing was perforated at 3,420-93 ft. After acidizing, it was estimated at 150 bbl. per day of 22-gravity black oil. This was the first deep test on the structure. About 25 wells had previously been drilled to the Frontier sands at around 400 ft. These were abandoned except for a few small stripper wells.

Test for Keeline district.—The Texas Co. is rigging up for a wildcat 12 miles southwest of the Lance Creek field, Niobrara County, Wyoming, in its 1 Charles Henderson, SE NW SE 18-33n-66w. Location is close to the town of Keeline and in a district which heretofore has had no deep test.

Nebraska wildcat abandoned.—Texas 1 Egle, SE SE SW 29-4n-35w, Hamlet prospect, Hitchcock County, Nebraska, was plugged and abandoned at 5,015 ft. It had the Arbuckle at 4,900 ft., the Regan at 5,011 ft., and granite at 5,014 ft.

Tensleep at Big Sand Draw.—Sinclair-Wyoming Oil Co. 1 Unit, SW NW NW 14-32n-95w, Big Sand Draw field, Fremont County, Wyoming, which showed for an important discoverly in the Embar at 6,896-7,060 ft., topped the Tensleep at 7,281 ft. and stopped at that point to set the 7-in. before drilling into the sand. Heavy gas pressure prevented further drill-stem tests in the Embar after two were taken. The second one, at 6,930-55½ ft. and open 17 minutes, showed for 15,000,000 cu. ft. of gas with shutin pressure of 3,350 lb. At 6,896-6,913 ft. it showed 1,560 ft. of oil and 633 ft. of cut mud in 57 minutes.

Second Golden Eagle well near sand.—Pioneer Oil Corp. 2 On Time-OPC, C SW



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DUGAS DIVISION

SE 12-45n-97w, Golden Eagle Dome, Hot Springs County, Wyoming, ⅛ mile southeast of the discovery well brought in last June, is showing up favorably as it nears the objective. It is coring in the basal Frontier at 6,312 ft. and showing gas. The discovery had the Muddy sand at 6,724-70 ft. and made 250 bbl. of 58-gravity oil, along with 3,500,000 cu. ft. of gas, in a 12-hour test through choke on tubing. On a short wide-open test it indicated it would make three to four times that quantity.

Crook's Gap discovery flows.—Sinclair Wyoming Oil Co. 1 State, NW SW NW 18-28n-92w, Crook's Gap structure, Fremont County, Wyoming, reported last week a discovery in the Lakota sand, set the 7-in. at 5,313 ft. with 400 sacks, and on a 10½-hour test flowed 750 bbl. of fluid, of which 75 per cent was clean oil. It was shut in for lack of storage. An electric survey of the hole before setting pipe placed the top of the Dakota sand at 5,055 ft., and of the Lakota at 5,225 ft. This indicates that the production is coming from the Lakota instead of the Dakota, as at first reported. The first drill-stem test, at 5,234-48 ft., open 47 minutes, flowed at the rate of 50 bbl. an hour the last 15 minutes. The second test, at 5,282-5,391 ft., open 10 minutes, showed 1,680 ft. of oil and 750 ft. of water. The oil is light and of 37.1 gravity.

Dry hole at Spring Creek.—Phillips Petroleum Co. 1 Hintze, a mile to the north of the Sinclair Wyoming discovery at Crook's Gap, Wyo., was plugged and abandoned at 4,808 ft. Spring Creek and Crook's Gap structures are parallel anticlines, trending northwest-southeast and are separated by a narrow syncline. The Phillips well showed increasingly steep dips with additional depth and proved to be at an unfavorable location. The rig is being skidded 990 ft. east and 660 ft. north for a second test.

WYOMING WILDCAT COMPLETIONS

Kirby Creek, Hot Springs County: Pacific Western Oil Corp. 1 Government, SE NE NE 21-43n-92w, TD 4,427 ft., water in Tensleep and Madison, plugged back to Embar and flowed est. 150 bbl. per day, 22° gravity black oil from perforations at 3,420-93 ft. Tops Embar 3,418 ft., Tensleep 3,678 ft., Madison 4,342 ft.

Spring Creek, Fremont County: Phillips 1 Hintze, SE NW NW 7-28n-92w, dry, TD 4,808 ft.

MONTANA WILDCAT COMPLETION

West Pondera, Teton County: Texas 1 Price, NE SE NE 12-27n-5w, dry, TD 2,173 ft., Ellis-Madison 2,145 ft.

MICHIGAN

Seven Oil Wells Among 14 Completions Reported

SAGINAW.—The 14 completions reported during the past week included seven oil wells, two gas wells and five dry holes. The Conservation Department issued 13 drilling permits, two each for locations in Allegan, Bay, Isabella and Osceola counties; one each for Montmorency, Ottawa, Mecosta, Missaulee and Muskegon.

Initial daily potential of the new wells was near 2,500 bbl., including a 1,500-bbl. producer in the Arenac-Deep River pool and a well in the Coldwater pool of Isabella County, which flowed 385 bbl. pinched. Three of the five dry holes were wildcat tests.

Reaching out into less promising areas, Michigan oil and gas operators opened more land to exploration this year than they did in 1943, the Michigan Conserva-

tion Department reports. Last week's final auction on state-owned lands for the year brought to 216,065 the acreage leased in 1944. This is 20,246 acres more than in 1943. Bonuses paid declined a little, the state realizing $179,571 from the sales, $383 less than in 1943.

MICHIGAN WILDCAT COMPLETIONS

Allegan County, Fillmore Township: J. E. Hood 1 Gerrit DeFouw, SW SW SE 17-4n-15w, dry at 2,175 ft.

Bay County, Williams Township: J. V. Wicklund Development Co. 1 L. and E. Shudark, NW NE NW 31-14n-3e, dry at 4,125 ft.

Gladwin County, Secord Township: W. L. McClanahan 1 F. H. and M. Boman, N½ NW SE 15-19n-1e, dry at 3,541 ft.

N. CENTRAL TEXAS

Fain-McGaha Gets 822-Bbl. Producer in Clay County

WICHITA FALLS.—Fain-McGaha Oil Corp. 1 O. A. Ross, wildcat about a mile southwest of the Ross pool, western Clay County, was completed last week for a potential of 822 bbl. of 42-gravity oil through ½-in. choke from Caddo lime pay at 5,395-5,435 ft. Tubing pressure was 110 lb., casing pressure 880 lb., gas-oil ratio 750. Development may link this new producer with the Ross pool, where production is found in the Caddo at approximately the same depth.

Grayson County.—Pure Oil Co. 1 Little, 2 miles southwest of Gordonville, was drilling ahead at 7,969 ft. in hard sand and streaks of shale, with slight show of oil in hard sand from 7,934-69 ft. Seitz, Comegys & Seitz et al 1 Walling, 4 miles east of Tioga, topped the Ellenburger at 4,210 ft. and was plugged and abandoned at 4,388 ft. The Texas Co. 1 J. R. Handy is a new wildcat location 20 miles north of Whitesboro, to be drilled to 3,500 ft.

Montague County.—Sinclair Prairie Oil Co. is starting a new test at 1 Frank Foster, 6 miles southwest of Nocona, in the southwest corner of Lot 179, Belcher subdivision of the J. Olabarri Survey, a 7,000-ft. test. Stanolind Oil & Gas Co. 1 Gossett, 8 miles southwest of Bowie, recovered 25 ft. of mud on a drill-stem test of conglomerate, showing oil at 5,757-60 ft. and was drilling ahead below 6,501 ft.

Hardeman County.—Amerada Petroleum Corp. 1 Conley et al, 8 miles southeast of Quanah, topped the Canyon at 5,223 ft., had lime with oil odor at 5,255-58 ft. and 5,275-85 ft., and was drilling at 5,520 ft. in lime.

King County.—Ohio Oil Co. 2 Ross, wildcat 16 miles east of Guthrie, was drilling at 3,318 ft. in shale. Shamrock Oil & Gas Corp. 2 Masterson is a new wildcat location in the southeast corner of the R. M. Thompson Survey, Section 164, Block "A".

WEST CENTRAL TEXAS WILDCAT COMPLETION

Taylor County: Geo-Chemical Survey, Inc. et al 1 W. D. Haynes est., Lot 5, W. R. Willis Sur. A-122, 4 mi. SE Merkel, elev. 1,836 ft., Noodle Creek 2,115 ft., Flippin 2,428 ft., dry, TD 2,490 ft.

NORTH CENTRAL TEXAS WILDCAT COMPLETIONS

Archer County: D. H. Bolin 2-A Bill Threet, Lot 106, Jefferson CSL, A-240, 3 mi. N and 4 mi. E Anarene, dry, TD 1,137 ft.

Geo. W. Cooper et al 1 Kemp & Kempner, Sec. 5, SPRR Sur. A-418, 3 mi. N and 1½ mi. E Mankins, elev. 1,036 ft., Caddo 4,240 ft., dry, TD 4,669 ft.

Chas. E. Morrison Drlg. & Prod. Co. and Maguire Ind., Inc. 1 W. M. McGregor, Lot 7, Brazos CSL, 4 mi. E and 1½ mi. N Luke Wilson, elev. 951 ft., dry, TD 884 ft.

Avis B. Taylor et al 1 Mrs. J. R. Moore, Lot 57, Blk. 4, Clark & Plumb Subd., 6 mi. E and 2 mi. S Archer City, dry, TD 1,121 ft.

Frank Wood et al 1 L. F. Wilson est., Sec. 9, ATNCL Sur., 6 mi. S and 2 mi. W Holliday, dry, TD 4,005 ft.

Cooke County: S. D. Johnson et al 1 Betty Gatewood, MEP&P Sur. A-766, 1¼ mi. W and 2½ mi. S Myra, IP 157 bbl. day, TD 1,581 ft.

The Texas Co. 1 Royal McGeorge, H. Walker Sur. A-1,082, 3 mi. S and 3 mi. W Woodbine, elev. 813 ft., Ellenburger 3,600 ft., dry, TD 3,838 ft.

Continental Oil Co. 1 J. R. McNutt, ETRR Sur. A-1,069, 2 mi. S and 1 mi. W Bowie, elev. 1,019 ft., Viola 6,715 ft., plugged back to 6,950 ft., flowed 266 bbl. day through 12/64-in. choke on 2-in. tubing, gas-oil ratio 1,000 to 1, gravity 50, TD 7,299 ft.

Montague County: J. A. Chapman 1 Westheimer-Daube, N. Kimbrough Sur. A-405, 2 mi. W and 3 mi. S Belcherville, elev. 880 ft., Ellenburger 6,504 ft., dry, TD 6,710 ft.

CALIFORNIA

Big Well in Buena Vista Hills Runs Wild

LOS ANGELES.—North American's well No. 81 in Section 2-32s-23e, at Buena Vista Hills suddenly blew in this week

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doing from 5,000 to 10,000 bbl. per day and ran wild for several days before being brought under control. Fortunately the well did not take fire as it would have probably destroyed Standard Oil Co. of California's Buena Vista absorption plant located nearby. A close 24-hour watch was placed on the wild well and this permitted Standard to continue operation of its natural-gasoline plant.

In addition to being the largest well at Buena Vista Hills since discovery of the lower zone by Standard several months ago, it is the largest flow registered in any California field in several years. North American's crews had not noticed any great amount of gas during the course of drilling and had anticipated completion of a pumping well. Dikes were hastily thrown up, but most of the oil was lost. The well was finally killed with pressure and heavy mud. This well is the first to show production in Section 3-32s-23e, all of which is owned by North American.

The numerous blowouts during recent months, after several years of comparative freedom from such incidents, have caused safety engineers to make a study to ascertain the trouble. There have been too many blowouts to be traced to carelessness as some of the companies involved have had long experience in drilling.

Shell Oil Co., Inc. appears to have a new oil field in Hasley Canyon in the Newhall-Castaic quadrangle although the discovery well, 88-4 Claiborne, has been on production for a short time and then off again due to sand trouble. Initial production, 25 bbl. daily of 14°-gravity oil, has shown cuts varying from 5 per cent to 23 per cent and consisting mostly of a free flowing sand. This wildcat was drilled to 6,010 ft., plugged back to 3,700 ft. and whipstocked to 4,015 ft. The bottom of the hole was lost by a complicated fishing job, the fish consistently failing back into the hole so it was decided to try out the upper sand which had been logged during drilling.

Barnsdall Oil Co.'s deep test in the Newhall Potrero field is drilling and coring at 8,070 ft. but no formation data are available. This test is considered very promising. All three productive zones at Newhall Potrero are undoubtedly above the equivalent of the Sesnon zone, which has been found so prolific in the Aliso Canyon field, and there is a large thickness of Miocene sediments present.

CALIFORNIA WILDCAT COMPLETIONS

Dixon outpost well, Solano County: Amerada Petroleum Corp. 1 Sorenson, 19-6n-3e, dry in gray sand, TD 6,504 ft., form. test 2,778-80 ft. recovered 50 ft. mud, form. test 3,260-90 ft. recovered 2,600 ft. water, no oil or gas.

Mount Poso outpost well, Kern County: Beatty & Steele 1 B.S., 29-27s-28e, dry in hard gray sand, TD 2,345 ft., Vedder zone of Miocene topped at 2,320 ft. was barren.

Poso outpost well, Kern County: Gene Reid Drilling Co. 1 Winston, 27-27s-27e, abandoned as wet and not commercially productive, tested wet at 2,226 ft., squeezed, shot at 2,330 ft., tested wet, squeezed, shot at 2,260 ft., tested wet, cemented and plugged, TD 3,427 ft.

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KANSAS

Poor Week for Wildcatters 11 Tests Prove Failures

KANSAS had a poor wildcat week with 11 completions, all dry. Out of 39 field wells, 18 made oil and 5 good gas wells were completed in the Hugoton field. New starts are normal, with 42 locations scheduled, of which 10 are wildcats. New locations for wildcats are widely scattered with Cowley County taking the lead with 2, and one apiece slated for Butler, Greenwood, Leavenworth, Marion, Rice, Rooks, Sedgwick, and Sherman counties.

Butler County: Marlyn 1 Doule, SE SE NW 22-29s-5e, west of the Fox-Bush pool, is bailing 4 bbl. oil and 1 bbl. water from Mississippi lime at 2,383-2,931 ft. Kansas City lime was cut at 2,172 ft.

Ellis County: Sunray Oil Co. 1 Weisner, SW SE NE 30-12s-20w, just north of Ellis pool, is dry, after attempts to complete it as an oil producer failed. Between 3,875-80 ft. there was an estimated ¾ bbl. oil per hour, with little water, but in drilling ahead, the oil decreased and the water increased, until at 3,892 ft. the hole filled with 250 ft. of water in 1¼ hours.

McPherson County: M & L Oil Co. 1 Runbeck, W/2 SW SW 8-17s-3w, in the Lindsborg pool, is making an estimated 75 bbl. per day. After cutting crystalline Viola at 3,388 ft., plug was drilled to 3,410 ft., where fluid was swabbed that was 70 per cent water. Hole was then plugged back to 3,350 ft., and perforated twice with eight and nine shots, respectively, at 3,340-46 ft. Acidizing with 1,000 gal. failed to help. Drilling was resumed and at 3,415½ ft. the well made 75 bbl. per day. Testing is continuing.

Harry Gore 1 Brack, SW SW NE 17-15s-12w, just south of Lewis pool, in Russell County, is making oil from the Lansing at 3,303 ft. After filling up with 2,000 ft. oil, the well pumped 70 bbl. in 16 hours, with no water, then pumped 31 bbl. in 7 hours. After acidizing with 2,000 gal., the well pumped only 3½ bbl. oil in 24 hours.

Russell County: Coralena Oil Co. 1 Al-

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len, SE SW NE 29-14s-15w, about 2 miles west of Big Creek pool, is making an estimated 1 bbl. oil per hour at 3,182-90 ft., with no water, after acidizing. Topeka was topped at 2,734 ft., Dodge 2,989 ft., Lansing 3,017 ft., conglomerate 3,262 ft., and Arbuckle at 3,282 ft. The Arbuckle was dry at total depth 3,294 ft., and the hole was plugged back to 3,194 ft. before acidizing.

KANSAS WILDCAT COMPLETIONS

Barton County: Vickers 1 Bortz, SE NE NW 32-17s-11w, dry, TD 3,401 ft., Arbuckle 3,351 ft.

Butler County: Ward McGinnis et al 1 Columbian Hog & Cattle Co., NE NE SW 12-25s-7e, dry, TD 2,808 ft., Chattanooga 2,793 ft.

E. S. Adkins 1 Taylor, NW NW NE 17-27s-4e, dry, TD 2,886 ft., Arbuckle 2,846 ft.

Ellis County: Texas 1 Elmore, SE SE SW 35-15s-20w, dry, TD 3,842 ft., solid granite 3,840 ft.

Greenwood County: Glenn Smith et al 1 Evans, SW SE SE 3-23s-8e, dry, TD 2,760 ft., Mississippi lime 2,685 ft.

Hodgeman County: Texas 1 Goebel, NE NE SE 16-21s-24w, dry, TD 5,028 ft., Arbuckle 4,969 ft.

Lane County: Shallow Water 1 Erickson, NW NW NW 19-19s-29w, dry, TD 4,656 ft., base Neva 3,385 ft.

Leavenworth County: Mosbacker 1 Sloan, SW SW NE 16-9s-22e, dry, TD 1,468 ft., Burlington 1,348 ft.

McPherson County: Coralena 1 Jacobson, SE NW NW 29-17s-2w, dry, TD 2,445 ft., Lansing 2,441 ft.

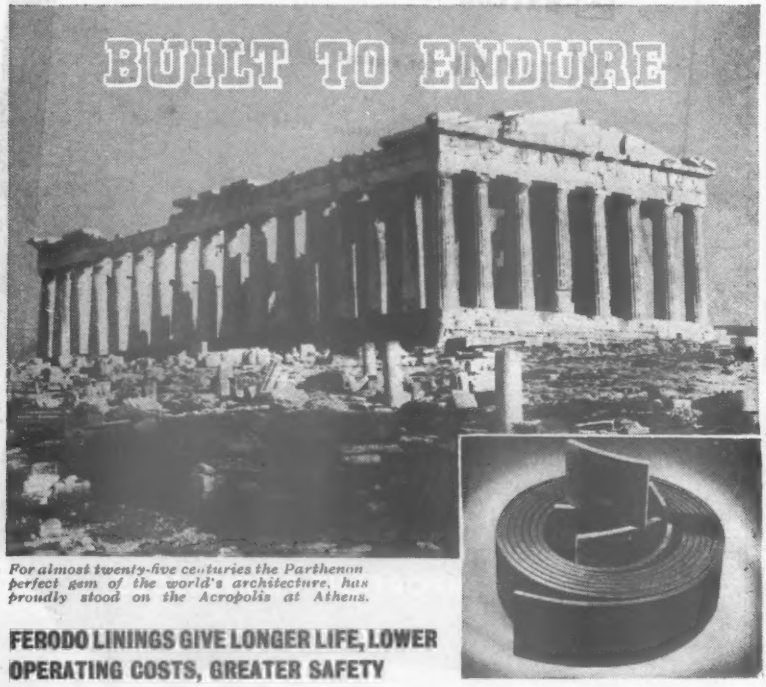
Cummings 1 Carey, SE SW SW 16-17s-2w, dry, TD 3,107 ft., Mississippi lime 3,070 ft.

Rooks County: Globe Oil & Refining et al 1 Federal Farm Mortgage, NW NW NE 20-9s-19w, dry, TD 3,649 ft., Arbuckle 3,596 ft.

FOREST CITY BASIN

Magnolia Petroleum 1 Imus, SE NE SW 15-10s-19e, Jefferson County, Kansas, about 5 miles southwest of the McLouth oil and gas field, topped Viola lime at 2,193 ft., drilled to 2,256 ft. and set 5-in. pipe at 2,235 ft. The company was preparing to drill one location to the northeast at 1 National Life in SE SW NE 15-10s-19e, Jefferson County.

L. M. Bates et al 1 Fritz, SE SE SE 34-3n-15e, Richardson County, Nebraska, 1½ miles north of Verdon, was drilling below 1,300 ft. This test is ¾ mile north of the old I.T.I.O. Banker's Life, in which there was a showing of oil in the Hunton limestone.



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New Field for Union County In Smackover Lime

MAGNOLIA-ROOT PETROLEUM CO. 1 Union Sawmill, NW NW 27-18s-12w, a wildcat test 2¼ miles from the New London pool, appears to be good for 100 bbl. per day of 32° gravity oil from the Smackover lime at 6,319-24 ft., with not enough gas to flow. The present depth is a recompletion, after testing some oil, gas and salt water at 6,326-42 ft.

McAlester Fuel Co. 1 Wilson-McRae, SE SW 28-16s-18w, second well in the Salem Church condensate pool, flowed 58 bbl. daily of condensate with 2,500,000 cu. ft. of gas, 13/64-in. choke, tubing pressure 1,850 lb., after perforating the Smackover lime with 72 shots at 6,966-72 ft. The McAlester well is ½ mile north and ¾ mile east of the Carter Oil Co. discovery well, which opened the pool in July. Before completing at its present depth, the McAlester well had salt water in open hole in the Smackover at 7,065-67 ft., below casing set at 7,065 ft.

ARKANSAS WILDCAT COMPLETION

Hempstead County: Barnsdall and Sohio 1 Cox, W/2 NE SW 2-14s-26w, dry, TD 5,412 ft., elev. 260 ft., Smackover 5,196 ft.

NORTH LOUISIANA WILDCAT COMPLETIONS

Bossier Parish: Barnsdall 1 Hanks, SW NE 7-20n-12w, 164 bbl. condensate from pay zone 8,001-40 ft., TD 8,765 ft., "D" sand in Cotton Valley, 8,001 ft.

LaSalle Parish: Atlantic Refining 1 Hardtner, NW NE 3-10n-2e, dry, TD 3,993 ft.

Lincoln Parish: California 1 Norris, NW NE 15-18n-1w, 97 bbl. condensate from Cotton Valley at 9,060-80 ft., TD 9,768 ft.

South American Field Notes

NEW YORK.—On the Barco oil concession in Colombia, owned by the Colombian Petroleum Co., 9 Socuavo in the new Tibu oil field has been completed as a flowing well, total depth 5,385 ft. No. 10 is standing at 5,384 ft., while No. 11 is testing at 5,181 ft. Nos. 12 and 13 in the same field were drilling at 4,440 ft. and 3,710 ft., respectively, at last reports.

The Sindicato de Inversiones, S.A., owned jointly by Socony-Vacuum Oil Co., Inc., and Tropical Oil Co., reports that its wildcat test, 1 Floresanto, in the Sinu area of Colombia, is drilling at 2,615 ft.

Socony-Vacuum Oil Co. 6 Cantagallo in the Magdalena River district of Colombia, is rigging up. In Venezuela, Socony-Vacuum Oil Co., Inc., reports the following operations currently:

No. 8 Guario in the San Joaquin field, eastern Venezuela, being completed at total depth of 10,735 ft., while No. 11 is drilling at 6,505 ft. In the Oficina field, 3 Guico has a fishing job at 5,941 ft., and 4 Guico is rigging up.

Typical of the exhaustive field tests which marked the development of the modern, high speed Cummins Diesel, was the gruelling 14-day grind which came to an end on Christmas Day, 1932, at the Indianapolis Speedway. Here, under AAA supervision, a Cummins-powered Indiana truck set a non-stop distance record for trucks: 14,600 miles (5,840 laps of the 2½-mile oval!).

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Cooperatives Plan to Widen Their Petroleum Activities

KANSAS CITY.—Plans for a federation of cooperative wholesalers in the United States, Canada, England, Scotland, Sweden and other countries, to handle oil products, food and related commodities, were announced here last week at the annual meeting of Consumers Cooperative Association by Howard A. Cowden, president. The plans, Cowden said, contemplate incorporation of such an international organization under the District of Columbia Cooperative Act on December 21, the hundredth anniversary of the first cooperative, in Rochdale, England.

The project has been approved by the Cooperative League National Cooperatives, Inc., and by the directors of Consumers Cooperative Association. The new organization plans to enter into petroleum production, processing and distribution, and ownership of oil lands, pipe lines and refineries both here and abroad.

Two directors of the Scottish Cooperative Wholesale Society, Glasgow, are here to discuss the proposed international cooperative and to look over the petroleum facilities of United States and Canadian cooperatives. There are nine cooperative refineries in the United States and one in Canada, Cowden said. In addition they own a growing number of producing oil wells and around 1,000 miles of oil pipe lines.

"World trade in the postwar period," Cowden said, "likely will be carried on to an increasing extent by cartels—those operated for private profit and those managed by government. The international oil compact quite likely is the forerunner of similar arrangements to come in other commodities. We in the cooperative movement believe that both types of cartels need the checks and balances that strong, well-financed international cooperatives will impose. We have a mixed economy in the United States now, in which many types of business, plus some government in business, operate side by side. We should have a mixed economy in the international field as well, in the view of many cooperative leaders."

The largest purchase during the year was at Coffeyville, Kans., where the refining facilities, oil-producing properties, undeveloped oil leases and pipe-line facilities of National Refining Co. were taken over by the cooperative. In addition, the $6,500,000 aviation-gasoline refinery built there by the federal Government is being operated by the refining division of CCA.

Frank J. Kuckert, supervisor of stocks and materials for Carter Oil Co. in Tulsa, has retired after 26 years' service.

Most of America's Coal Will Yield Liquid Fuel

WASHINGTON. — Experiments show that most of America's vast coal reserves—estimated at 3 trillion tons — will yield liquid fuels, according to a technical paper released by the Bureau of Mines, presenting a review of its research during the past 8 years in making gasoline and oil from coal and lignite. The bureau is now beginning an expanded 5-year program in preparation for the day when natural petroleum reserves no longer can meet the growing demand for motor fuels and lubricants.

Need Basic Technical Knowledge

Although conducted on a small scale, this preliminary research has provided basic technical knowledge needed to launch an intensive program of advanced research and development under which synthetic-fuel laboratories and demonstration plants will be built and operated by the bureau to "iron out the kinks" for private industry.

Prepared by Dr. Arno C. Fieldner, chief of the bureau's fuels and explosives branch; Dr. Henry H. Storch, supervising chemist, and Dr. Lester L. Hirst, physical chemist, the review explains in detail the experiments in hydrogenation and liquefaction conducted at the bureau's laboratory-scale plant at Pittsburgh, a continuous unit capable of hydrogenating 100 lb. of coal in 24 hours. It also presents chemical-process information obtained in batch-hydrogenation tests conducted in small steel autoclaves or bombs.

Some coals are more easily liquefied and give better yields than others. Fifteen coals obtained from beds in 11 states and Alaska and ranging in rank from lignite to high volatile bituminous were tested in the experimental plant.

Characteristics of Oils

Physical characteristics and chemical compositions of the oils from the various coals were found to be influenced principally by operating conditions. These oils, readily converted to gasoline by high-pressure hydrogenation, also provide chemicals of commercial value, such as tar acids for plastics and benzene, toluene, and xylene for explosives and solvents. The yield of tar acids and tar bases is about 10 times that obtained in coal carbonization, the authors state.

An unabridged copy of Technical Paper 666, "Bureau of Mines Research on the Hydrogenation and Liquefaction of Coal and Lignite," may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 15 cents. It is not for sale by the Bureau of Mines.

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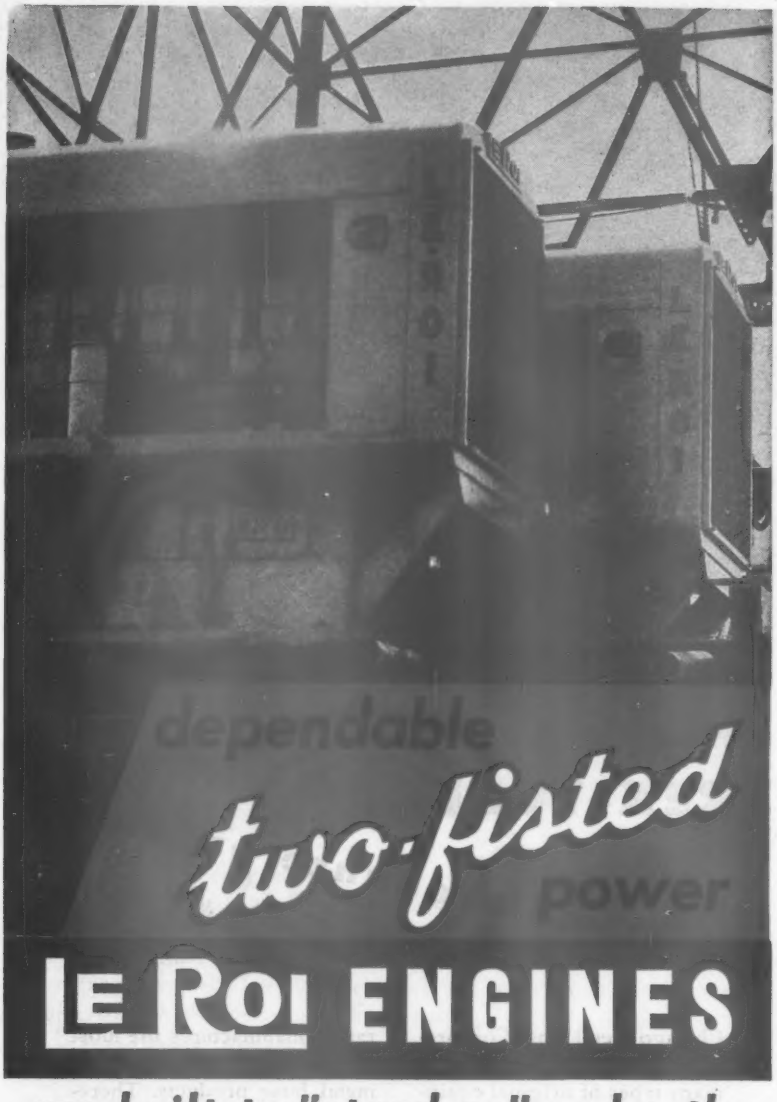

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MARKET QUOTATIONS

Prices as of November 14, 1944

(This service is abbreviated because most refinery products are selling at the Government's price ceilings. Quotations on other products than those shown here furnished on request. Quotations are f.o.b. plant in tank cars and in cents per gallon).

REFINERY GASOLINE

Octane (A.S.T.M.)	76†	70-74
Mid-Continent*	6.75	5.875
Gulf Coast	6.75	5.625
Northeast Coast		9.075
California		6.50-7.00

*Basic Oklahoma Group 3. †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	4.750	5.700
North Texas (Dist. 1 Del.)	4.500	5.400
North Texas (f.o.b. plant)	4.375	5.250
North Louisiana (Dist. 1 Del.)	5.160	6.060
North Louisiana (f.o.b. plant)	4.375	5.250
California	4.875	5.500

CRUDE-OIL PRICES

Representative posted schedules per bbl.

East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana	1.18
Illinois basin	1.37
Pecos County, Texas	.95
Bradford, Pennsylvania	3.80
Van, Van Zandt County, Texas	1.00

Note: Exclusive of subsidy.

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity:	Signal Hill, Calif.	Okla-homa, Kansas	Gulf Coast Texas	West Texas*
18-18.9	$0.80	....	....	....
19-19.9	.84	....	$1.06	$0.70
20-20.9	.88	$0.85	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	....	1.07	1.30	.94
32-32.9	....	1.09	1.32	.96
33-33.9	....	1.11	1.34	.98
34-34.9	....	1.13	1.36	1.00
35-35.9	....	1.15	1.38	1.02
36-36.9	....	1.17	1.40	1.04
37-37.9	....	1.19	1.42	1.06
38-38.9	....	1.21	1.44	1.08
39-39.1	....	1.23	1.46	1.10
40 and above		1.25	1.48	1.12

*Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT

Week ended Nov. 4, 1944

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gaso-line	Stocks: Resid-ual	Stocks: Gas oil
East Coast	731	12,301	11,046	14,793
Appalachian	157	3,683	472	709
Ind., Ill., Ky.	771	*16,126	*3,889	*6,801
Okla., Kan., Mo.	338	*7,037	*1,657	*2,465
Inland Texas	218	2,634	645	398
Tex. Gulf Coast	1,093	14,192	8,533	8,308
La. Gulf Coast	272	4,258	1,023	2,244
N. La. and Ark.	72	2,409	319	731
Rockies	113	1,570	639	412
California	805	14,199	35,221	11,616
Total 11- 4-44	4,570	78,409	63,444	48,477
Total 10-28-44	4,658	79,058	†64,382	†48,705
Total 11- 6-43	4,097	68,674	63,398	44,807

*Previous week revised. †Revised.

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended—	Bbl. of crude*
November 4, 1944	222,894,000
October 28, 1944	223,235,000
November 6, 1943	236,937,000

*Excludes unrefinable California stocks.

FLORIDA

Eight Active Tests in Seven Florida Counties

TALLAHASSEE.—Of a total of 10 wells carried on the drilling report for Florida, only 2 are shut down, 5 are making hole and 3 are active locations on which preparations are being made to drill. Humble Oil & Refining Co. has a test drilling in Collier County and another in Dade County; one location each in Collier and Highlands counties respectively. Pure Oil Co. has a test drilling in Gulf County; Stanolind Oil & Gas Co. has one drilling in Leon County; Hunt Oil Co. has one drilling in Madison County, and O. D. Robinson is drilling piling for a test in Barnes Sound in Monroe County. Florida Oil & Refining Co. 1 Everglades in 31-53s-35e, Dade County, is shut down at 10,174 ft., and Miami Ship Building Corp. 1 Grossman in 25-55s-37e, Dade County, is shut down at 420 ft., after setting 12½-in. surface pipe.

MISSISSIPPI WILDCAT COMPLETIONS

Holmes County: Roy L. Fisher 1 Thompson, NE SW SW 24-14n-2w, dry, TD 6,320 ft., Lower Cretaceous 6,211 ft.

Jones County: Gulf 1 Graves-Lindsey-McLauren, NW SE 20-9n-10w, dry, TD

Prince Edward Island Test Drilling Below 10,000 Ft.

NEW YORK.—It is reported that the wildcat test well being drilled by Socony-Vacuum Oil Co. and Cities Service Co. jointly in the Hillsborough district, Prince Edward Island, is down to total depth of 10,214 ft.

WILDCAT COMPLETIONS AND DISCOVERIES

	Week ended Nov. 11, 1944					Cumulative total, 1944				
	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ohio	0	0	0	2	2	2	0	17	61	80
Indiana	0	0	0	1	1	4	0	0	21	25
Illinois	2	0	0	8	10	31	0	0	282	313
Kentucky	0	0	0	2	2	14	0	0	75	89
Michigan	0	0	0	3	3	12	0	3	214	229
Kansas	0	0	0	11	11	46	0	9	381	436
Neb., Mo., Iowa	0	0	0	0	0	1	0	0	15	16
Oklahoma	2	0	0	1	3	64	1	20	236	321
Texas:										
North Central	2	0	0	8	10	58	0	1	270	329
West	1	0	0	6	7	40	0	3	159	202
Panhandle	0	0	0	0	0	0	0	2	9	11
Eastern	0	0	0	3	3	5	0	4	111	120
Gulf Coast	1	0	1	6	8	31	12	14	202	259
Southwest	0	0	0	2	2	21	4	15	208	248
Total Texas	4	0	1	25	30	155	16	39	959	1,169
Louisiana:										
Northern	0	2	0	1	3	5	2	2	52	61
Southern	1	0	1	2	4	9	6	1	42	58
Total Louisiana	1	2	1	3	7	14	8	3	94	119
Arkansas	0	0	0	1	1	2	1	0	52	55
Mississippi	0	0	0	2	2	3	0	0	59	62
Ala., Ga., Florida	0	0	0	0	0	2	0	0	27	29
Montana	0	0	0	1	1	3	0	4	43	50
Wyoming	1	0	0	1	2	17	0	2	19	38
Colorado-Utah	0	0	0	0	0	3	0	1	25	29
New Mexico	1	0	0	0	1	7	0	3	48	58
California	0	0	0	3	3	6	0	8	164	178
Total United States	11	2	2	64	79	386	26	109	2,775	3,296
Total previous week	4	0	0	66	70					

J. E. Brown Appointed To New Position

J. E. Brown has been appointed assistant to the general sales manager of Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co. Brown joined Pittsburgh Meter Co. in 1906. Upon the consolidation of that firm with Equitable Meter Co. in 1926, he was made manager of the Chicago district office, but returned to Pittsburgh the following year as director of sales. In 1942 the home office sales order department was placed under his jurisdiction. He will continue to manage this department.

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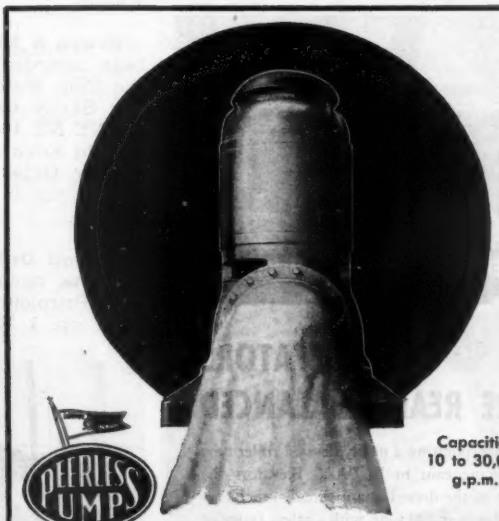

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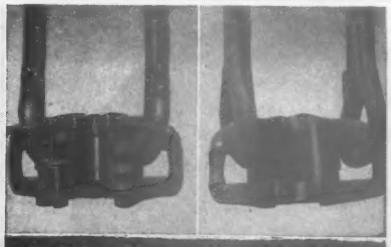

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By incorporating a newly devised roller type balancing cam in BJ "AA" Elevators the work of the derrick man is made much easier. Rated at 300 tons, with a safety factor of four to one, this elevator is made of high alloy steel—fully heat treated—flame hardened on the top bore to minimize upsetting —and is equipped with an unusually sturdy latch. Ask the BJ man or your supplier.

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Among the

Drilling Contractors

Howard Brunson is the drilling contractor on a new wildcat test in Ellis County, Kansas. Max Cohen has made location for the 1 Madden Estate in NW NW NE 4-13-17w. This is a farmout from Sunray Oil Corp. and the test is being supported by Stanolind Oil & Gas Co. and Transwestern Oil Co. Location is 1 mile northeast of the old Catherine pool production.

E. H. Adair is the contractor on a test that will be drilled by Adair and J. M. Huber Corp. at 1 Jacobshagen, in SW SW SW 6-31-5e, Cowley County, Kansas. Location is on a large block of acreage assembled by General Exploration, Inc.

F. C. Miller is the contractor on the J. M. Huber Corp. 1 Mokler, in C NW NE 22-12-20e, in the southwest corner of Leavenworth County, Kansas.

Rowan & Nichols Drilling Co. has been awarded drilling contract on the Tide Water Associated Oil Co. and Skelly Oil Co. 1 Baldwin, in SE NE NE 10-9n-25w, deep test in the old Erick gas field of Beckham County, Oklahoma. Test was rigged up and due to spud. Contract is for 9,000 ft.

Summit Drilling Co. has contract and was moving in on Mid-Continent Petroleum Corp. and Mid-Co Oil Corp. 1 Robertson, in NW SE NE 30-24-1w, Noble County, Oklahoma, near the old South Tonkawa field.

Loffland Brothers will drill the California Co. 2 J. S. Nordan, in SE NE 10-6n-8e, Lincoln County, Mississippi, direct offset to the discovery well. Well was preparing to spud, and a steam rig will be used.

Stoner Drilling Co. is the contractor on the John Green, Jr., 1 Lucille G. Dawsey, in C SW SE 29-10n-4w, Choctaw County, Alabama. Contractors were waiting on rotary table.

Penrod Drilling Co. was rigging up on its contract at the Hassie Hunt, trustee, 1 Dr. J. W. Rudder, in C NE SW SW 7-11n-3w, Choctaw County, Alabama.

Cook Drilling Co. has been awarded drilling contract on the Carter Oil Co. 1 Massey-Wicker unit, in NE SW NE 10-11n-3e, in the Pickens field, Madison County, Mississippi. Contractor was waiting for rig.

Woolf Drilling Co. was rigging up on its contract at Gulf Refining Co. 3 E. H. Bradshaw, in NE SE SW 29-3n-17w, Marion County, Mississippi.

C. B. Miller is the drilling contractor on the Alan W. Winchester A-1 William Commans, in NE NW NW 27-3n-13w, Allegan County, Michigan.

Day crew of Lambert Drilling Co., West Edmond field, Oklahoma. The men are Sam Harkey, Everett Dye, Wilson McCracken, A. M. Van Orden, Jim Wray (driller), and S. G. Walker (drilling superintendent)

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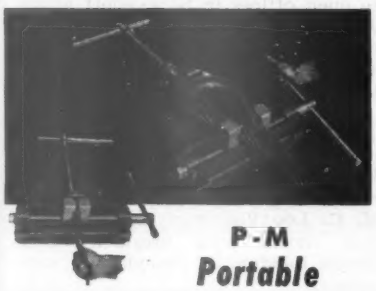

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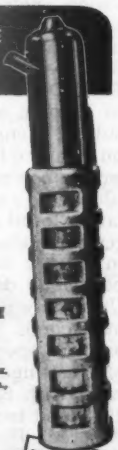

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Patrick & Tyrrell Drilling Co. contractors on the Gulf Refining Co. 1 Edwards-Bailey unit, was moving in derrick and rig. The test is located in NE NW SE 27-10n-13w, Jasper County, Mississippi.

Lupher Drilling Co. will drill three tests in Isabella County, Michigan, for Sohio Petroleum Co. These are the Clara Swan et al, in C N½ SE SW 29-16n-6w; the 1 Edwin S. Cole, in C N½ SW NE 32-16n-6w, and the 1 Beulah M. Durkee, in C N½ NE NW 32-16n-6w. Lupher also has a contract on the Pure Oil Co. 1 C. C. Winkler, in C E½ NE SE 6-14n-11w, Newaygo County, Michigan.

Regent Drilling Co. of Calgary, Alta., is handling a well for Franco Oil & Development Co. in LSD 3, 14-49-28w3, in the Saskatchewan end of the Lloydminster field.

Newell & Chandler of Galgary, Alta., have moved a rotary outfit to the Jenner extension of the Steveville-Princess field, to complete Goyette-Solloway 1, LSD 9, 30-20-7w4, from 1,400 ft. The same company is drilling California-Conrad 55-33-B, LSD 11, 33-5-15w5, and moving equipment from the recently completed 77-33-B producer to California-Conrad 55-21-B, LSD 11, 21-5-15w4, in the Conrad area of the Taber field.

S.W.S. Drilling Contractors, of Edmonton and Lloydminster, Alta., are drilling below 1,000 ft. on a test west of Blackfoot, Alta., for Lloyd Oil Producers.

Alberta Drilling & Development Co. of Calgary, Alta., has contract with Trans-Alberta Oils to complete the Twin Province 1, 21-11-29w3 in western Saskatchewan. The well, drilled to 3,695 ft. with standard outfit, will be completed with rotary to test the Devonian limestone, expected around 4,000 ft. **General Petroleums,** under supervision of S. Addison, will core each foot to completion.

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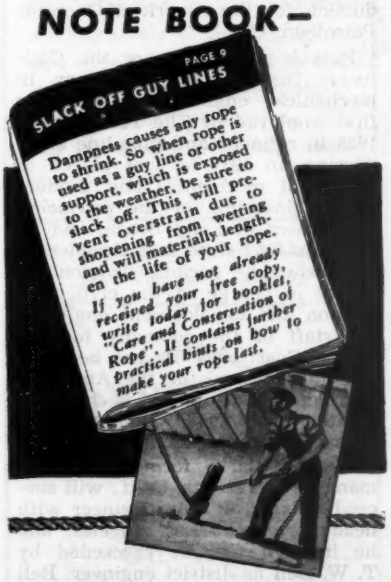
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PERSONALS

J. H. PULS

Superintendent's Job Culminates 20-Year Career

J. H. PULS has been appointed superintendent of drilling and production in the Pacific Coast division of The Texas Co., succeeding W. H. Farrand, who has been transferred to San Francisco as director and vice president in charge of production for the American Overseas Petroleum Co.

Puls is a graduate of the California Institute of Technology in mechanical engineering, and was first employed by The Texas Co. in 1925 in refinery and pipe-line engineering. In 1937 he was placed in charge of mechanical and production engineering for the producing department at Long Beach, and he was transferred to Los Angeles in 1940 when he became division engineer in charge of the civil, production and development engineering staff of the company for the Pacific Coast area. He has been active in the work of the American Petroleum Institute and is chairman of the California committee on pumping equipment.

W. A. Clark, formerly district manager at Fellows, Calif., will succeed Puls as division engineer with headquarters at Los Angeles, and he in turn will be succeeded by T. W. Bell as district engineer. Bell was formerly production engineer at Fellows.

Myron R. Holmgren, formerly vice president of Hughes Oil Co., Chicago, is returning to that company as executive vice president and general manager, following several months' service as director of fuel-oil rationing in Office of Price Administration.

Lt. Col. Frank S. Vaden, Jr., who was in the oil and gas business in San Antonio when called to active military duty in November 1940, is now serving in the Salween campaign combat zone on the Y-Force operations staff, southwestern China. Colonel Vaden, a graduate of Texas A. & M. College, is a member of a liaison team accompanying the Chinese expeditionary force to give medical and other technical assistance and to advise Chinese commanders. He has directed Chinese artillery fire and on one occasion spent 4 days in an artillery observation post under continuous Japanese artillery and mortar fire.

Paul Ryan, Cleveland, former president of National Refining Co. but recently holding an important post in Petroleum Industry War Council, has been elected a vice president of The M. W. Kellogg Co., petroleum and chemical engineers, of Jersey City, N. J., and New York. Ryan will manage a newly instituted consulting service which will provide counsel for refiners in the adequate evaluation of the factors of production, refining, transportation, marketing and finance.

Miller R. Henderson, formerly Fresno County, California, foreman for Pacific Gas & Electric Co., has taken an overseas post with Arabian American Oil Co., serving in a supervisory capacity in the electrical construction department. He is in San Francisco, making arrangements for his trip.

V. E. Peterson, member of Magnolia Petroleum Co.'s geological staff, with headquarters in Roswell, N. M., during the past year, has been assigned to Midland, Tex.

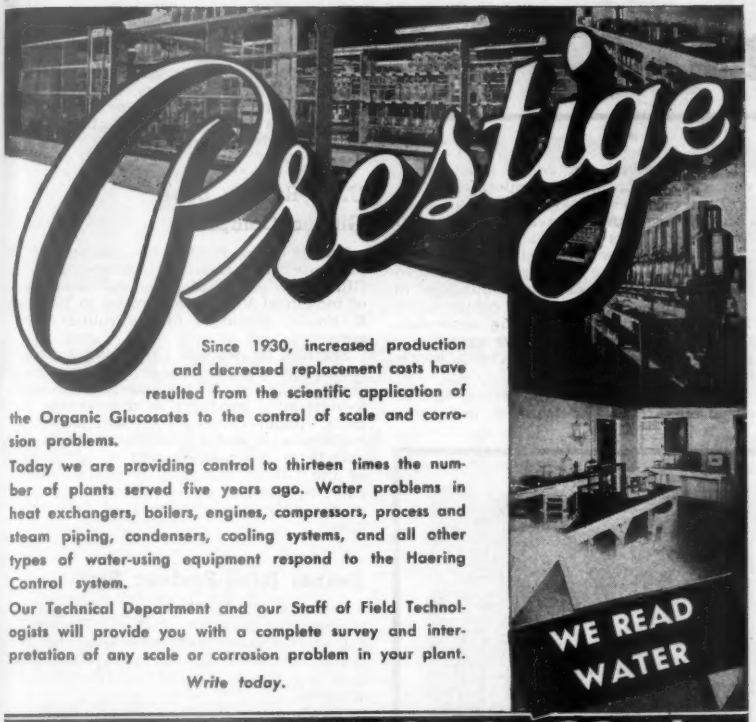
Terry Duce, executive vice president and director of Arabian-American Oil Co., owned jointly by The Texas Co. and Standard Oil Co. of California, returned recently to the United States from a visit to the company's properties in the Near East. He is now located at the company's headquarters in San Francisco.

Alec M. Crowell has resigned as director of Arkansas Oil and Gas Commission, an office he has filled 6 years. His resignation becomes effective December 1, and he plans to open offices in Shreveport about January 1 to look after his own oil and gas interests in Arkansas and to serve as a consulting petroleum engineer.

L. B. Blalock, Dallas, was elected president of Petroleum Electric Power Association at the annual meeting held last week in Dallas. **H. C. Leo Vis,** Port Arthur, Tex., was chosen vice president, and **Duane Landon,** St. Joseph, Mo., secretary.

Dwight Shoemaker, who served for a year as a key man in the pipeline transportation division of Petroleum Administration for War, is back in Midland, Tex., as a member of the scouting staff of Humble Oil & Refining Co.'s geological and land department.

C. H. Keplinger has resigned as division petroleum engineer, Oklahoma division, Mid-Continent area, Shell Oil Co., Inc., to become a consulting engineer on petroleum problems, particularly those relating to oil and gas evaluation, and reservoir studies, with headquarters in Tulsa. Keplinger received his bachelor's degree in engineering at University of Tulsa, master's degree at George Washington University, and did special work at University of Goettingen, in Germany. He had been with Shell Oil Co., Inc., since 1933, and before that he worked for Amerada Petroleum Corp., National Tank Co., and Loffland Brothers. His experience includes service in California, Texas, Illinois, and Oklahoma.



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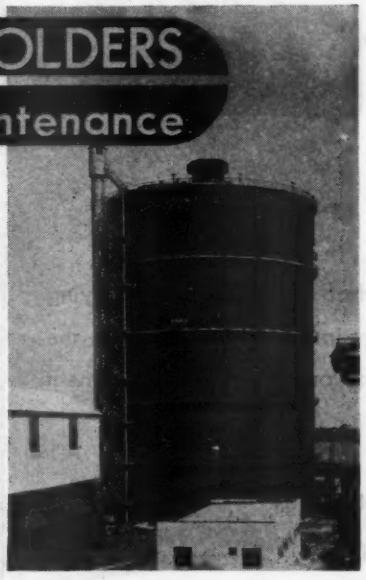

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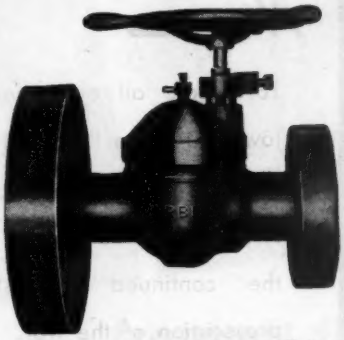
MASTER VALVE WITH UNEQUAL FLANGES

The ORBIT GEAR OPERATED MASTER VALVE makes your Christmas Tree more compact by eliminating the use of an adapter flange—also eliminating chances for additional gasket leaks. The Unequal Flanges are cast integral with the body of the Valve.



Orbit Gear Operated Master Valve

This valve can be furnished thru all fabricators of Xmas Trees or thru any of your local supply stores at a price comparable to that of leading plug valves, YET, this valve requires no lubrication to effect a seal.

See Pages 2194 to 2111 in 1944 Composite Catalog

ORBIT VALVES

OIL WELL IMPROVEMENTS CO.
TULSA, OKLAHOMA

Industrial Items

Dresser Acquires International-Stacey and Its Subsidiaries

Oscar M. Havekotte, of Columbus, Ohio, has been elected a director of Dresser Industries, Inc., Bradford, Pa., President H. N. Mallon has announced. Havekotte, for the past 4 years president of International-Stacey Corp. and of International Derrick & Equipment Co., both Columbus concerns, will continue as head of the latter company.

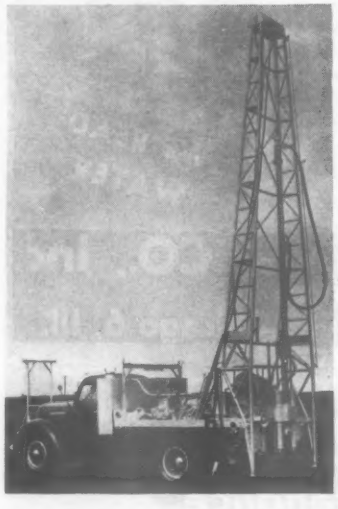
Dresser Industries has acquired the assets of International-Stacey Corp., which will be dissolved, and of its subsidiaries, which will continue in operation. The acquisition gives Dresser a leading position among manufacturers of equipment for the oil, gas and water fields. The 10 companies now comprising the Dresser group manufacture a completely rounded line of products, from pipe couplings to large pumps, blowers and compressors. They include derricks, drilling apparatus, radio and airport towers and equipment, gas-storage tanks and gas-fired home-heating equipment.

As International-Stacey winds up its corporate affairs, its factories and those of its subsidiary companies will continue in full operation, without change of local managements. International Derrick & Equipment Co., Roots-Connersville Blower Corp., and Stacey Brothers Gas Construction Co. become new units in the Dresser group, each continuing to operate under its own name.

OUR PROGRAM

Now—

To devote all our efforts toward rushing the needed products we are manufacturing which contribute to the continued successful prosecution of the war.



Postwar—

To contribute to the peace that will follow by supplying our old friends and customers in the oil industry with the same high quality portable exploration drilling equipment we did before . . . such as,

- Shot Hole Drills
- Core Drills
- Slim Hole Drills

ENID Franks MACHINE CO. OKLAHOMA

U. S. Rubber Buys Gilmer Company

United States Rubber Co. has agreed to purchase the assets and business of L. H. Gilmer Co. of Philadelphia, manufacturers of industrial V-belts, according to Herbert E. Smith, president of the rubber company.

Founded in 1907 and employing approximately 600 people, Gilmer lists among its chief articles of manufacture besides V-belts such products as automobile fan belts, rubber covered rolls and industrial truck wheels and other related items. No change in the management or operations of the Gilmer company is contemplated. John S. Krauss, president, will continue in the active management of this business.

Renner Joins Foxboro Staff

Foxboro Co., Foxboro, Mass., announces the addition of Frank Renner to the staff of sales engineers covering the southern California territory. His headquarters are at Foxboro's office in Los Angeles.

New Rotary Hose Announced by Goodrich

Utilizing an especially oil-resistant type of synthetic rubber, a new type of rotary hose for oil-well drilling is announced by Goodyear Tire & Rubber Co.

The new hose is said to be especially resistant also to sunlight and aging. The hose is supplied with flanged ends to provide a full-flow hose with a uniform inside diameter.

Rotary hose of the new type construction is used in oil-well drilling to supply a special type of mud to the drilling bits. In its return to the tops of the wells, the mud carries off the drillings of shale and rock and other materials which the bits pierce.

Reinforced with steel-cable helices for each section's entire length, the new hose was described as resistant to pressures of more than 5,000 lb. per sq. in.

D. D. Foster Co. Named Hills-McCanna Representative

Hills-McCanna Co., Chicago, announces appointment of D. D. Foster Co. as representative in the Pittsburgh area with offices at 412 Peoples Gas Building.

Ajax Awarded Maritime "M"

Ajax Iron Works, Corry, Pa., was recently awarded the Maritime "M" Pennant and Victory Fleet Flag, for outstanding production achievement. C. F. Bliss, president of Ajax, accepted the award on behalf of employes.

Raybestos Wins D.M.A.A. Award

The Raybestos Division of Raybestos-Manhattan, Inc., Stratford, Conn., was awarded a prize at the annual meeting of the Direct Mail Advertising Association held at the Hotel Roosevelt in New York City on its employe-serviceman house organ, The Firing Line, which was judged among the 50 best promotional campaigns of the many participating.